Policy options for climate change loss and damage: A case study from Fijian agriculture

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Doctor of Philosophy

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Abstract

Anthropogenic climate change loss and damage (L&D) includes adverse consequences of climate change due to sudden and slow-onset events despite the implementation of adaptation and mitigation measures. Given this context, this thesis aims to identify institutional and policy gaps in the understanding of L&D and critically evaluate opportunities for policy, planning, and funding mechanisms for anthropogenic climate change L&D within the sugar industry of Fiji.

Through a grounded theoretical lens, qualitative research was used to gain in-depth insights into climate change L&D from cyclones and droughts in the Fijian sugar industry. In-depth semi-structured interviews (n=68) were conducted with farmers from two Indo-Fijian sugarcane communities, Barotu and Toko settlements in Western Viti Levu, Fiji, and with key stakeholders from government ministries, academia, and climate change experts at the national level. Additionally, policies at the national strategic level and the Ministry of Sugar Industry were examined to understand the degree to which climate change information has been mainstreamed into policy and action in the sugar industry.

Vulnerability analysis in both Barotu and Toko settlements revealed a high vulnerability to cyclones and droughts. Cyclone and drought adaptation measures were implemented in Barotu and Toko settlements and by the Ministry of Sugar Industry. Adaptation measures ranged from bearing the effects of cyclones and droughts, reactive coping measures, incremental measures, and systems adaptation. Despite implementing adaptation measures, Fiji's sugar industry has faced severe L&D from droughts and cyclones. L&D included loss of property, crops, and income. Farmers classified loss of homes and livestock as both economic losses and non-economic L&D (NELD) due to economic and sentimental significance. Other NELD included loss of place of worship, heightening of uncertainty, fear, and trauma. Cascading and flow-on effects included food insecurity risks and impact on children's education. The severity of L&D experiences suggests that the communities have approached social and ecological limits and are living with intolerable risks and irreversible L&D. The findings also indicate that L&D, including NELD, are highly context-specific and depend upon local value systems, how people experience L&D, and how they deal with L&D.

The Fijian Ministry of Sugar Industry lacks the capacity to respond to and address L&D. The lack of capacity is primarily due to insufficient climate change policies, lack of human resource capacity, limited adaptation technologies, lack of L&D data and tools, and lack of access to sufficient climate finance. This research highlights that to facilitate adequate adaptation that moderates or avoids harm and implementation of mechanisms to address L&D, attention must be paid to broader social, economic, and political processes at the international, national, sectoral, and community levels. The systematic documentation of L&D within vulnerable communities should improve understanding of L&D, including NELD, and assist to facilitate the mobilisation of urgent support and action to address L&D in countries that lack the capacities to respond independently. Therefore, this research recommends critical policy interventions to avert and minimise L&D such as livelihood and product diversification with access to new markets, developing risk profiles, mainstreaming climate change and disaster risk reduction issues into existing policies, as well as addressing L&D through enhancing institutional capacity to access climate finance.

Declaration

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Moleen Monita Nand

5th September 2022

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Dedication

This thesis is dedicated to my father. I hope you are proud of me.

To my grandmother, my *nani*, – you are a vessel of wisdom, strength, and determination.

This thesis is also dedicated to all farmers of Fiji.

Abbreviation and Acronyms

AF - Adaptation Fund

AOSIS - Alliance of the Small Island States

CAF - Cancun Adaptation Framework

CAS - Complex adaptive systems

CCA - Climate change adaptation

CDM - Clean Development Mechanism

CePaCT - Centre for Pacific Crops and Trees

COP - Conference of Parties

CRM - Comprehensive risk management

CSR - Colonial Sugar Refining

DRR - Disaster risk reduction

ECAL- Environment and Climate Adaptation Levy

ENSO - El Niño Southern Oscillation

FAO - Food and Agriculture Organisation of the United Nations

FSC - Fiji Sugar Corporation Limited

FSLC - Food Security and Livelihoods Cluster

GCF - Green Climate Fund

GDP - Gross domestic products

GEF - Global Environment Facility

GHG - Greenhouse gas

IPCC - Intergovernmental Panel on Climate Change

L&D - Loss and damage

LDCs - Least Developed Countries

LDCF - Least Developed Countries Fund

NAP - National Adaptation Plan

NAPA - National Adaptation Programmes of Action

NCCP- National Climate Change Policy

NDC - Nationally Determined Contributions

NDMO - National Disaster Management Office

NDRRP - National Disaster Risk Reduction Policy

NELD - Non-economic loss and damage

PDNA - Post Disaster Needs Assessment

PEA - Probabilistic Event Attribution

PCRAFI - Pacific Catastrophe Risk Assessment and Insurance Initiative

PICs - Pacific Island Countries

PICPP - Pacific Islands Climate Prediction Project

REFOREST- Reforestation of the Degraded Foothills of the Sugar Belt

SCCF - Special Climate Change Fund

SES – Social-ecological systems

SIDS - Small Island Developing States

SNLD - Santiago Network for Loss and Damage

SOP - Standard Operating Procedure

SPCZ - South Pacific Convergence Zone

SSI - Semi-structured interviews

TC - Tropical cyclone

UNFCCC - United Nation’s Framework Convention on Climate Change

WIM - Warsaw International Mechanism

WIM ExCom - Warsaw International Mechanism Executive Committee

WTO - World Trade Organisation

Chapter 1: Introduction and significance of the research

1.1 Introduction

The Republic of Fiji Islands (hereafter called Fiji) is highly vulnerable to the impacts of climate change (Ministry of Economy 2019). Fiji's contribution to global greenhouse gas emissions (GHG) is insignificant, however, climate change impacts have a drastic impact on Fiji. The irreversible (non-reversible or permanent) climatic risks challenge livelihoods, food security, and health and well-being (Currenti et al. 2019; Thomas et al. 2018). As climate change intensifies, there will be a need to scale up successful mitigation and adaptation measures (van der Geest et al. 2019a). Yet, adjusting to changing climatic conditions may present some adaptation limits that would result in climate change loss and damage (L&D) (Warner & van der Geest 2013). Recent research has documented severe L&D such as loss of livelihood and income and non-economic L&D (NELD) such as loss of biodiversity, cultural and religious sites, ancestral land, mental and emotional health, trauma, and anxiety in various countries (van der Geest & Warner 2015; McNamara et al. 2021; Pill 2021; Thomas et al. 2018). Regardless, how people perceive economic and non-economic L&D would depend on people's experiences and what they value (Barnett et al. 2016).

However, there has been a lack of L&D research in Fijian agriculture which is the backbone of Fiji. To date, this is the first study in Fiji's sugar industry examining L&D from cyclones and droughts. Through a qualitative approach, this research aims to examine local lived experiences of L&D, L&D institutional and policy gaps, and critically evaluate opportunities for policy, planning, and funding mechanisms for averting, minimising, and addressing anthropogenic climate change L&D within the sugar industry of Fiji. This study will further unpack some of the key issues and challenges that need to be considered by local, national, and international actors when developing and implementing policies to avert, minimise, and address L&D. The theoretical aim of this thesis is to examine vulnerability and L&D in Fiji's sugar industry with the use of social-ecological systems (SES) theory and demonstrate the crucial role of adaptive governance and transformational adaptation in addressing L&D. More importantly, SES theory is used to develop a conceptual L&D framework relevant for the local sugarcane communities and the Fijian sugarcane industry to enable SES resilience. This research emphasises that only by explicitly understanding the local social and ecological context, meaningful responses to L&D could be developed.

This chapter begins by introducing the concept of climate change and climate change L&D in Section 1.2. Section 1.3 sets the scene for the research problem. The aim of this study, with research objectives and research questions, are outlined in Section 1.4. Section 1.5 introduces the research methods used to meet the research objectives. This section is then followed by research significance highlighting the need for understanding vulnerability in SES, L&D, and their policy implications. Section 1.7 provides the thesis structure.

1.2 Research background

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report defined climate change as "change of climate that is attributed directly or indirectly to human activity that alters the composition of the human atmosphere and that is in addition to natural climate variability observed over comparable time periods" IPCC (2007, p. 6). Many Pacific communities have been adapting to changing climatic risks for many centuries and have

shown strong resilience through their local adaptive capacity (Warrick et al. 2017). Yet, the severity of climatic risks is undermining coping and adaptation strategies resulting in L&D IPCC 2022).

Pacific island communities are severely impacted by sea-level rise, changes in rainfall, tropical cyclones, and storm surges (IPCC 2022). Changes in climate present unprecedented risks to vulnerable people and will have a range of impacts on various sectors such as tourism, fisheries, and agriculture - all of which are highly climate-sensitive. This further poses a risk to local livelihoods, food security, water supply, infrastructure, and human health and well-being (Allen et al. 2018; Barnett 2011; Nurse et al. 2014).

The impacts of climate change that cannot be addressed through adequate mitigation and adaptation strategies is formally regarded as climate change L&D (Pinninti 2013; Roberts & Pelling 2018). Although there is no universally agreed definition of L&D (Durand & Huq 2015), the United Nations Framework Convention on Climate Change (UNFCCC) working definition of L&D is "the actual and/or potential manifestation of impacts associated with climate change in developing countries that negatively affect human and natural systems" (UNFCCC 2012, p. 3).

The UNFCCC's Warsaw International Mechanism (WIM) recognised the need to "address loss and damage associated with the impacts of climate change, including extreme and slow-onset events, in developing countries that are particularly vulnerable to adverse effects of climate change" (UNFCCC 2014, p. 6). Article 8 of the Paris Agreement also acknowledged "the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow-onset events and the role of sustainable development in reducing the risk of loss and damage" (UNFCCC 2015, p. 12). The Paris Agreement also established global average temperature goal of limiting warming to well below 2 ℃ above pre-industrial levels, with an aspirational goal of limiting warming to 1.5 ℃ (UNFCCC 2015a). Clearly, these goals acknowledge that further warming will take place and countries must prepare and anticipate for increased impacts of climate change, including L&D. By acknowledging L&D as a third area of concern, it is evident that the Paris Agreement recognised that some climate change impacts are beyond local adaptation capacities.

Mechler & Schinko (2016) differentiated between the two terms "loss" and "damage" in the L&D context. Loss refers to adverse impacts to which reparation or restoration is impossible. This includes permanent and irreversible impacts, such as loss of freshwater resources, loss of habitat, and loss of life. By contrast, damage refers to adverse impacts in relation to which reparation or restoration is possible. This includes reversible impacts such as damage to infrastructure, or damage to a coastal mangrove forest as a result of coastal surges. A further distinction is made between economic L&D and non-economic L&D (NELD). Economic L&D are loss of resources and goods and services commonly traded in the market (Preston 2017). NELD refer to a broad range of losses that are non-financial and not commonly traded in the market (UNFCCC 2021a). Examples of NELD include loss of habitat, loss of biodiversity and ecosystem services, loss of lives, and loss of ancestral land (Talakia 2015). L&D can also be categorised as direct and indirect. In this thesis, climate change L&D and NELD will be referred to as L&D unless otherwise specified.

Previous L&D research in vulnerable countries has shown that despite implementing a range of adaptation measures, many communities still face severe L&D from sudden and slow-onset events (van der Geest & Warner 2015; Monnereau & Abraham 2013; Warner & van der Geest 2013; Yaffa 2013). Hence, L&D is not an issue that will be experienced in the near future. Rather vulnerable communities are experiencing devastating L&D now (Thomas & Benjamin 2018a). Various L&D research have captured the present-day realities of vulnerable communities and emphasises how vulnerable communities are approaching their social and ecological limits, facing irreversible losses, and intolerable risks (Handmer & Nalau 2019; Mechler & Schinko 2016).

Although WIM and Paris Agreement acknowledge L&D as an area of great concern, little progress has been made under the UNFCCC to mobilise resources to assist vulnerable countries to avert, minimise, and address L&D (Kreienkamp & Vanhala 2017; Richards 2018). For instance, support and action, including L&D finance, have been slow to arrive (Sharma-Khushal et al. 2022). Consequently, there have been ongoing calls for a meaningful international L&D debate and more ambitious actions to address L&D (Wewerinke-Singh & Salili 2019).

Even under the ambition to limit global temperature increase to 1.5 ℃ above pre-industrial level, vulnerable countries still need to prepare and anticipate full array of climate change impacts and L&D (Carty & Walsh 2022; McNamara, Westoby & Chandra 2021; Thomas et al. 2020). Under a 1.5 ℃ or warmer world, there are growing concerns that L&D will accelerate, affecting food and water security, health of SES, biodiversity and ecosystems, and future ways of being (McNamara et al. 2021). As vulnerable communities continue to suffer disproportionally from climate change impacts and L&D, there is an urgent need to mobilise action and support, including finance, to assist vulnerable countries to avert, minimise, and address L&D. Just as importantly, there is a need to understand how people experience losses, what people value, and how L&D, NELD, and cascading effects are interrelated (Barnett et al. 2016; Tschakert, Ellis, C. Anderson, et al. 2019).

1.3 Research problem: Climate change loss and damage in Fiji's sugar industry

Recent research on L&D in Pacific Island Countries (PICs) has documented severe L&D such as loss of livelihood, loss of land, loss of indigenous knowledge, loss of cultural sites, and cascading effects on SES (Charan, Kaur & Singh 2018; McNamara, Westoby & Chandra 2021; Pearce et al. 2018; Thomas et al. 2018; Thomas & Benjamin 2018b). To date, a lot of L&D studies in Fiji has been focused on relocation of coastal communities. These studies emphasise loss of ancestral land, loss of identity, loss of cultural heritage, a split in the community and loss of social network, loss of livelihood and income, and loss of sense of belonging (Charan, Kaur & Singh 2018; McNamara & Jacot Des Combes 2015; Piggott-McKellar et al. 2019). Yet, very little emphasis has been placed on the Fijian agricultural sector and L&D, particularly rural and remote Indo-Fijian sugarcane communities.

Fiji's economy is largely dependent on agriculture and has been regularly disrupted by tropical cyclones and droughts (Esler 2016; Terry & Raj 2014; Thomas et al. 2018). Fijian agriculture is diverse and consists of crops, livestock, fisheries, and forests (Republic of Fiji 2017). Subsistence farming and sugarcane are the dominant agricultural systems (FAO 2012a). Sugarcane is considered an economically important crop as 22 percent of Fiji's population are directly or indirectly dependent on the sugar industry in the Western and

Northern Divisions for their livelihoods (Chandra et al. 2018). Previously, the agricultural sector was regarded as the backbone of the Fijian economy with sugarcane as the main crop but the situation is changing (Fiji Government 2019a).

Fiji is exposed to a large number of natural risks and climate change, being a threat multiplier, will amplify these risks (The World Bank 2018). The largest island of Fiji, Viti Levu, has been estimated to incur climate-related disaster costs equivalent to 2-4 percent of Fiji's gross domestic product (GDP) by 2050 (Falco & Sharma-Khushal 2019). Additionally, the main factors that increase agricultural communities' vulnerabilities to climate change are socio-economic factors (Thomas et al. 2018), changes in weather patterns, including earlier onset of rainfall, warmer temperatures, severe flooding, increasing salinity, sea-level rise, more intense cyclones, and frequent droughts (Currenti et al. 2019; Pearce et al. 2018).

Recent cyclones in Fiji such as tropical cyclone (TC) Winston have caused massive L&D in the sugar industry. Sugarcane production drastically declined as TC Winston made landfall during the planting season (Esler 2016). As a consequence, loss of yield affected household income and food security. Significant infrastructural damages were noted to farm sheds, roads, and sugar mill infrastructure (Esler 2016). Many sugarcane farmers were displaced for a significant period of time (FSC 2016) while some lived in damaged houses and tents (Nakamura & Kanemasu 2020).

According to the Post Disaster Needs Assessment (PDNA) report from TC Winston, the estimated value of damage to sugar industry was FJ$21.8 million while the estimated value of loss was FJ$53.6 million (Esler 2016). However, research by Rowan Gard & Veitayaki (2017) indicated that estimated loss in the sugar industry amounted to FJ$163.35 million. While the Fijian government was quick to respond, international aid was heavily relied on for recovery and rehabilitation purposes (Rowan Gard & Veitayaki 2017).

Likewise, drought is also a concern for the sugar industry (Terry & Raj 2014). Widespread drought presents a significant challenge for farmers with severe consequences for employment, income, and health (Terry & Raj 2014). Severe droughts have resulted in loss of sugarcane yield or totally destroyed sugarcane farms which affected income generation activities and livelihood (Feresi et al. 2000). Other impacts of drought include mortality of livestock, loss of soil fertility (Feresi et al. 2000; Lightfoot 1999), and NELD such as health issues (Richards 2018).

Evidently, Fiji's sugar industry continues to be affected by sudden and slow-onset events with severe consequences for SES. Of great concern is that L&D studies have not been prioritised in Fiji's sugar industry. Therefore, there is implicit documentation and understanding of local experiences and context-specific L&D in the Fijian sugar industry. The lack of attention towards L&D research and governance in Fiji's sugar industry seriously undermines sugarcane farmers' livelihoods and the sustainability of the industry.

Prioritising L&D studies is particularly important to provide critical insights into understanding SES vulnerability, adaptation limits and barriers, and the range of L&D experienced by vulnerable communities. Additionally, paying particular attention to people's perceptions and local experiences of L&D and the interaction between SES and L&D allows us to comprehensively understand and respond to L&D across a range of social and ecological

domains. Finally, a comprehensive understanding of L&D will create opportunities to strengthen L&D governance with effective L&D policies and mechanisms directly targeted for addressing L&D at the local level.

1.4 Research aim and objectives

The aim of this thesis is to identify institutional and policy gaps in the understanding of L&D and critically evaluate opportunities for policy, planning, and funding mechanisms for anthropogenic climate change L&D within the sugar industry of Fiji. From this broader aim falls a series of more specific objectives, linked directly to the research questions.

The research objectives of this thesis are to:

1. Document the vulnerability of Fiji's sugarcane communities to sudden and slow-onset climatic events.
2. Identify current community-based adaptation strategies in Indo-Fijian sugarcane communities and residual L&D.
3. Assess whether the currently available support and action such as infrastructure, human capital, institutional arrangements, and mobilisation of L&D funding mechanisms are appropriate to address L&D in Fiji's sugarcane communities.
4. Evaluate institutional and policy gaps in Fiji to prevent, prepare, respond and recover from sudden and slow-onset events.
5. Construct the knowledge gathered to inform, design, and develop new support and action mechanisms such as infrastructure, human capital, and funding for sudden and slow-onset events for associated L&D.

The research questions are as follows:

1. What conditions make Fiji's sugarcane communities vulnerable to climatic stressors such as sudden events (cyclones) and slow-onset events (drought)?
2. What are the current community-based adaptation strategies in Indo-Fijian sugarcane communities and residual L&D?
3. Are the current action, support, and finance options available appropriate to address L&D in Fiji's sugarcane communities?
4. What are the institutional and policy gaps in Fiji to assist farming communities to prevent, prepare, respond and recover from sudden and slow-onset climatic events?
5. What new policies would be appropriate and relevant to ensure mobilisation of enhance infrastructure, human capital, and funding for L&D?

1.5 Research methods

This research uses an adapted pragmatic approach to grounded theory to fully understand and capture experiences of L&D in Fiji's sugarcane communities. Pragmatic constructivism has its origin in constructivism and post-positivist (Harrison et al. 2017). Pragmatic approach draws upon elements of both constructivism and post-positivist (Harrison et al. 2017) to interpret, categorise, manage information, and adapt findings to express clarity and applicability to the results (Haas & Haas 2002; Mills et al. 2017). Therefore, drawing on both elements of constructivism and post-positivist, this research assumes that reality is inter-subjectively constructed through meanings that are developed socially and through experience.

A multi-case study approach was employed in this research to gain an understanding of climate change L&D in Fiji's sugar industry. The selected field sites, Barotu and Toko settlements, are located in the Western division of the main island, Viti Levu. These field sites were selected as study sites as they have been identified as vulnerable to sudden events (cyclones) and slow-onset events (drought) through PDNA (Esler 2016) and climate change studies (Brown, Daigneault & Gawith 2017; Koroiwaqa 2016).

Data collection methods included literature review, semi-structured interviews (SSI), observations, and document analysis. This research used purposive sampling to identify key stakeholders for interview. Data analysis included transcription, coding, and categorisation in NVivo 12. Categorisation led to emergence of key themes which are conceptually analysed and presented in the results chapters. Document analysis was used to analyse text from national policies and international climate change negotiations. At the national level, national and sub-national policies were analysed to identify institutional gaps to avert, minimise, and address L&D. UNFCCC outcomes and L&D discourse were also analysed to explore power imbalance, climate justice, and the evolving nature of L&D discourse and practice. Finally, triangulation was employed to validate research design and methods.

1.6 Research significance

Climate change impact studies on human and ecological systems have the ability to broaden our understanding and knowledge of how people experience and respond to climate change-specific stressors (McNamara & Prasad 2014). Many climate change studies in Fiji have been centred on the issues of relocation, sea-level rise, and indigenous Fijian communities (Charan, Kaur & Singh 2018; Thomas et al. 2018). While these studies are important, to date, there has been no climate change L&D study conducted in Indo-Fijian sugarcane communities which remains an under-researched area. Therefore, this research aims to understand the multi-risk environment and associated SES vulnerability of Indo-Fijian sugarcane communities, implementation of adaptation measures, lived experiences of L&D, and the institutional capacity of the Ministry of Sugar Industry of avert, minimise, and address L&D.

1.6.1 Understanding vulnerability of Fiji's sugarcane communities

Understanding vulnerability is important in reducing current and future climate risks in SES (Thomas et al. 2018). Communities dependent on natural resources for food and livelihood are often vulnerable to climate change impacts (Thomas et al. 2018). Fiji's sugarcane communities are also very vulnerable to cyclones and droughts (Esler 2016; FSC 2016; Terry & Raj 2014). In Fiji, frequent severe tropical cyclones, droughts, and changes in severity and frequency of cyclones and droughts have a devastating impact on agricultural communities. Additionally, recent intensification of rainfall and storm events has increased exposure to flash flooding in rural communities (Nawai et al. 2015a; Neef et al. 2018). Severe cyclones coupled with heavy rainfall and floods acts as double exposure which reinforces community's vulnerability to biophysical impacts (Chandra & Gaganis 2016).

While recent studies have quantified damage to infrastructure and loss of yield in Fiji's sugar industry due to cyclones, floods, and droughts (Esler 2015, 2016; Koroiwaqa 2016), very little emphasis is given to documenting farmers' rich experiences of climatic events, such as cyclones and droughts, as well as their vulnerabilities. To address this research gap, this research aims to document Indo-Fijian sugarcane farmers' rich experiences of cyclones and droughts and highlight underlying root causes of farmers' vulnerability to cyclones and

droughts.

This study adds to the existing literature by documenting climatic and non-climatic stressors in two Indo-Fijian communities and documents how these stressors interact in a complex and complicated manner. As a result, this research will provide an understanding of multiple sources of SES vulnerability, including climatic and non-climatic stressors and how rural and remote communities experience and deal with these stressors. This research contributes to the existing scholarship on SES vulnerability by emphasising the crucial role of social and ecological foundations, that is, social and ecological well-being in reducing SES vulnerability. Additionally, this thesis emphasises that addressing root causes of SES vulnerability would provide opportunities to reduce exposure and sensitivity, enhance adaptive capacity as well as avert, minimise, and address L&D.

1.6.2 Limited knowledge and understanding how sugarcane farmers adapt to climate change and resulting L&D

Following a growing body of literature that explores issues of vulnerability, adaptation, and L&D in vulnerable countries (McNamara & Prasad 2014; Warner & van der Geest 2013; Yaffa 2013), this study documents farmers' rich experiences of L&D due to cyclones and drought in two Indo-Fijian sugarcane communities. In particular, this study investigates current adaptation practices within the context of Fiji's sugarcane communities and resulting L&D.

Evidence-based studies on adaptation measures have been undertaken in Fijian villages (Currenti et al. 2019; McNamara & Prasad 2014; Pearce et al. 2018). Only recently, various studies have been conducted in Indo-Fijian sugarcane farming communities to examine SES vulnerability, climatic risks, and the sustainability of Fiji's sugar industry (Anshuka et al. 2021a; Dean 2022a; Nakamura & Kanemasu 2020; Singh 2020). However, to date there has been no empirical study examining SES vulnerability in Indo-Fijian sugarcane communities, how Indo-Fijian sugarcane farmers adapt to cyclones and drought, lived experiences of L&D, and institutional capacity to avert, minimise, and address L&D.

This study expands current adaptation and L&D scholarship by examining current adaptation measures, adaptation constraints, and resulting L&D in Fiji's sugar industry. The study highlights that L&D, including NELD is context-specific and depends largely on what people value. Hence, an understanding of the significance of local values is important in determining how people experience and deal with L&D. These local values are important because it influences people's experiences and daily practises, defines people's way of living, their interaction with social networks, how people deal with grief, implement adaptation measures, and engage in future activities (Barnett et al. 2016).

Finally, this research aims to identify different categories of L&D experienced by the sugar industry. By identifying distinct categories of L&D in the sugar industry, appropriate interventions and policy reforms could be identified to enhance support and action for averting, minimising, and addressing L&D,

1.6.3 Policy implications for addressing L&D

The risk of L&D arising from cyclones and drought cannot be ignored. This research undertakes a critical analysis of Fiji's current institutional arrangements in place to reduce

current and future climate risks in Fiji's sugar industry. In order to understand the progress, this research examines Fiji's major policies that support climate change adaptation and L&D.

It is therefore imperative to understand how institutional arrangements and policies can drive climate adaptation as a way to avoid and address L&D. Through a policy review, this study highlights that Fiji's national policies on disaster risk reduction (DRR) and climate change adaptation (CCA) are well established with identified urgent action items and a strong institutional basis for implementation. In particular, this research examines the degree to which climate change information has been mainstreamed into policy and action in the sugar industry. By doing so, this research highlights opportunities for policy review and update to better inform and include climate considerations in the sugar industry.

This research contributes to L&D governance literature by emphasising the need to implement appropriate L&D policies and strengthen institutional capacities such as human, infrastructural, and financial capacity for addressing L&D in the sugar industry. Developing appropriate policies and strengthening institutional capacities is crucial for preventing the collapse of the sugar industry and for facilitating the full range of L&D measures, from planning to implementation. Additionally, key findings from this research can assist in understanding and better prepare for L&D.

At the international level, this evidence-based research could provide substantial support for urgent climate action and unjust climate impacts faced by vulnerable countries such as Fiji. Importantly, the operationalisation of UNFCCC's WIM and Santiago Network for Loss and Damage (SNLD), including provision of support, action, and climate finance needs to be accelerated to provide timely assistance to vulnerable countries for implementing approaches to avert, minimise, and address L&D.

1.7 Thesis structure

This chapter has introduced the research background, research aim and objectives, and the significance of this research. Chapter 2 beings by providing discourse on climate change L&D under the UNFCCC. The chapter then discusses the relevance and applicability of climate justice theory, adaptive cycle framework, and SES theory for this research. This section is followed by various conceptualisations of L&D by different scholars, examples of L&D faced by vulnerable countries, including, Fiji's sugar industry, and details on how L&D is currently being addressed in Fiji.

Details on research design and methodology is provided in Chapter 3. The chapter begins with an overview of the research's epistemologically position and pragmatic constructivism. A qualitative research approach was employed through the use of SSI. Chapter 3 provides rationale for selecting case studies and techniques used for primary data collection methods, including participant sampling, SSI, and document analysis. The chapter then outlines procedures for data analysis techniques and validity and reliability of research findings.

Chapters 4 to 7 analyse research data and present the results of this research. Chapter 4 documents vulnerability to climatic and non-climatic factors in Barotu and Toko settlements in the context of recent social and ecological changes. Impacts of cyclones and droughts, adaptation measures, and the resulting L&D are documented in Chapter 5. Chapter 6 examines whether the available support and action such as infrastructure, human capital, and

mobilisation of L&D funding mechanisms are sufficient to address L&D in Fiji's sugarcane communities. Chapter 7 examines gaps in existing policies and institutional arrangements at the national level to avert, minimise, and address L&D in the sugar industry. Chapter 8 presents a discussion and conclusion of this research. Included in this final chapter are policy recommendations for averting, minimising, and addressing climate change L&D in sugarcane communities. The chapter also highlights potential areas for future research for better understanding of climate change L&D, particularly NELD

Chapter 2: Climate change and loss and damage: In theory and a focus on Fiji

2.1 Introduction

Chapter 2 critically examines climate change loss and damage (L&D) discourse to date, highlighting the political nature of L&D debate, current understanding of L&D research, irreversible risks and unavoidable L&D experienced by vulnerable countries, and demonstrating the need for this study. Section 2.3 focuses on theoretical framework of climate justice and social-ecological systems (SES) theory and their relevance for this thesis. The chapter then reviews the different conceptualisations and frameworks of L&D proposed by different scholars. By doing so, it provides an understanding of L&D key concepts and the interconnected nature of these concepts. Section 2.5 presents evidence of L&D in vulnerable countries, emphasising that current adaptation measures are insufficient to avoid L&D. Section 2.6 discusses current measures to address L&D in vulnerable countries, including comprehensive risk management and climate finance. An overview of climate change and climate variability in Fiji is provided in Section 2.7 which also outlines current and future exposure and sensitivity to these climatic changes. The chapter then provides an overview of Fijian agriculture, including the sugar industry. Experiences of L&D from cyclones and droughts are detailed in Section 2.9. Section 2.10 provides an overview of how the Fijian government is averting, minimising, and addressing L&D. The chapter concludes in Section 2.11.

2.2 Discourse on addressing climate change loss and damage under the UNFCCC

Although there is no universally agreed definition of L&D (Durand & Huq 2015), the United Nations Framework Convention on Climate Change (UNFCCC) working definition of L&D is "the actual and/or potential manifestation of impacts associated with climate change in developing countries that negatively affect human and natural systems" (UNFCCC 2012, p. 3). L&D includes impacts from both extreme weather events and slow-onset events. In the context of L&D, damage refers to adverse impacts in relation to which reparation or restoration is possible. This includes reversible impacts such as damage to infrastructure, or damage to a coastal mangrove forest as a result of coastal surges (Burkett 2014). On the other hand, loss refers to climate-related impacts which cannot be restored within reasonable timeframes. This loss can be economic or non-economic in nature.

Under the UNFCCC, economic L&D are associated with adverse impacts of climate change, including sudden and slow-onset events, and categorised into income and physical assets. Recently, scholars have recognised economic L&D as irreplaceable and replaceable harm to society such as loss of livelihood, loss of income, loss of agricultural production, and damage to infrastructure (Esler, 2015; Handmer & Nalau, 2019; McNamara, Westoby, & Chandra, 2021; Yaffa, 2013). Therefore, economic L&D includes resources, goods, and services commonly traded in the market. Additionally, the UNFCCC categorises non-economic L&D (NELD) into three broad categories of losses often associated with impacts on individuals (loss of life, health, mobility), society (loss of territory, cultural heritage, and indigenous knowledge), and the environment (loss of biodiversity and ecosystems) (UNFCCC 2021a). Hence, NELD consists of a broad range of losses that are not widely traded in the market. NELD arises when people are dispossessed of highly valued possessions for which there is no substitute.

L&D negotiations within the UNFCCC have not been free of conflict. The history of L&D negotiations dates back to more than thirty years. In 1991, Vanuatu, as the chair of the Alliance of the Small Island States (AOSIS), proposed an international insurance scheme which some referred to as the compensation fund that would be generated by mandatory contributions from developed Parties (McNamara 2014; Talakia 2015; Wewerinke-Singh & Salili 2019). The proposed international insurance scheme explained how the resources of the insurance pool should be used to compensate the most vulnerable countries for L&D (Wewerinke-Singh & Salili 2019). However, the developed states rejected the insurance proposal and the insurance scheme fell off the UNFCCC's agenda. Since that time, concepts of mitigation and adaptation have been prioritised with only a recent return of interest in a possible third regime focusing on L&D.

After more than a decade, in UNFCCC's Conference of Parties (COP) 13 in 2007, L&D was recognised officially with the statement that "enhanced action on adaptation, including disaster reduction strategies and means to address loss and damage with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change" (UNFCCC 2008, p. 4). In 2008, an expanded version of a 1991 insurance scheme was submitted by AOSIS as a potential mechanism which became known as the *Multi-window mechanism to address loss and damage from climate change impacts*. This version proposed three interdependent components of any global response, including insurance, rehabilitation/compensation, and risk management (AOSIS 2008). However, the proposal was again rejected by several developed countries (ActionAid 2010).

Three years later, at COP 16 in 2010, an agreement was reached on a work programme on L&D under the Subsidiary Body of Implementation of the UNFCCC (UNFCCC 2011). Decision 1/CP.16 stated that "there is a need to strengthen international cooperation and expertise in order to understand and reduce loss and damage associated with adverse effects of climate change, including impacts related to extreme weather impacts and slow-onset events" (UNFCCC 2011, p. 6). Subsequently, at COP 17, decision 7/CP.17 recognised the need to explore a wide range of possible approaches and mechanisms to address L&D (UNFCCC 2012b). Vulnerable developing countries continued to build momentum at COP 18 where assurance on an L&D mechanism was received for the first time. At COP 18, there was a decision to establish a work programme on L&D that included a technical paper on enhancing the formal understanding of non-economic losses (Preston 2017).

In 2013, at COP 19 in Warsaw, Poland, 194 countries negotiated a best approach to institutionalise arrangements to address the issue of L&D under the UNFCCC. In the first week of the meeting, the G-77 and China proposed a L&D mechanism as the third pillar of the UNFCCC alongside mitigation and adaptation (McNamara 2014). Subsequently, the Warsaw International Mechanism (WIM) was established to "address loss and damage associated with impacts of climate change, including extreme events and slow-onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change" (UNFCCC 2014a, p. 6). The WIM aims to enhance knowledge and understanding of L&D, strengthen dialogue among stakeholders, and enhance action and support to address L&D (James et al. 2014). Parties have also agreed to improve understanding of NELD and slow-onset events (Huq, Roberts & Fenton 2013). Despite three clear WIM mandates to address L&D (UNFCCC 2014a, p. 7), the WIM has yet to identify how assistance and funding could be provided to individual states or regions (Page and Heyward 2017). At COP 20, the initial

two-year work plan of the WIM Executive Committee (ExCom) was approved for the operationalisation of the WIM mandate (UNFCCC 2015b). The work plan outlines nine action areas, including recovery and rehabilitation under action area five which was seen as a significant breakthrough for vulnerable countries (Wewerinke-Singh and Salili 2019).

Much progress was made through the Paris Agreement. Article 8 of the Paris Agreement recognised "the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow-onset events and the role of sustainable development in reducing the risk of loss and damage" (UNFCCC 2015b, p. 12). Avert and minimise strategies are preventive and pre-emptive measures such as disaster risk reduction and adaptation measures used to prevent and manage L&D (UNFCCC 2019a) while address strategies require transformative measures to address L&D. By acknowledging L&D as the third area of concern, in addition to mitigation and adaptation, it is evident that the Paris Agreement recognises that some climate change impacts are irreversible and vulnerable countries are approaching social and ecological limits that are beyond local adaptation capacities.

Article 9 of the Paris Agreement stated that "developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention" (UNFCCC 2015b, p. 13). Unfortunately, Article 9 did not provide a framework for a financial support mechanism for activities related to L&D under the WIM (Mace and Verheyen 2016; Roberts et al. 2017). Even though Article 9.4 prioritised the financial needs of developing countries, there was no mention of who will pay or how finance will be provided (UNFCCC 2015b). Roberts et al. (2017) believed that the failure to explicitly mention L&D under Article 9 is due to no clear definition of L&D or lack of appropriate approaches for L&D financing. The Paris Agreement also established limiting global average temperatures to well below 2 ℃ above pre-industrial levels, with an aspirational goal of limiting warming to 1.5 ℃ (UNFCCC 2015b). These goals acknowledge that further warming will occur and signal that countries must prepare and anticipate increased climatic impacts, including L&D (Thomas & Benjamin 2018a).

Since the establishment of WIM, it transitioned from its initial two-year work plan to its current five-year work plan. Yet, the mandate to enhance action and support, including the provision of finance to address L&D remains vague. Some particularly controversial matters were noted after COP 22, such as the withdrawal of the USA from the Paris Agreement after the election of President Trump which deprived the UNFCCC of US leadership, as seen earlier under President Obama. At COP 23, the Suva Expert Dialogue was organised (UNFCCC 2018a), with support from the COP President Fijian Prime Minister Bainimarama. However, the developed countries provided very little support for an actual mechanism to respond to financial concerns (Singh 2018). Furthermore, at COP 23, the developing states called for a new and additional finance for L&D (Wewerinke-Singh & Salili 2019). Regardless, developed countries consistently pushed back on the issue of L&D finance and avoided committing themselves to more than US$100 billion per year (Benjamin, Thomas & Haynes 2018).

The Katowice COP 24 was seen as a deadline for Parties to agree on the Rulebook of the Paris Agreement. Yet, L&D was not comprehensively described in the Rulebook and was only included under the Transparency Framework section for Impacts and Adaptation

(UNFCCC 2018d). At COP 24, developing countries were again hopeful for an outcome on a financial support mechanism for compensation for L&D, yet once again, no clear results emerged. As a result, the review of WIM for COP 25 neither acted as a catalyst for adopting a universal definition of L&D, nor advanced discussions on L&D finance, including deliberations on how both sudden and slow-onset events could be better attributed to climate change.

COP 25 had been seen as an opportunity to review the WIM by LDCs. In particular, it was seen as a key moment to examine whether the developing countries, together with G77 and China, would be able to push for a new financial facility for L&D, including transparent inclusion of L&D in operating entities of the Financial Mechanisms, enhanced capacity building and expanded institutional arrangements (Pierre-Nathoniel et al. 2019). Once again, however, while COP 25 recognised the urgency of mobilisation of action and support, the outcome did not provide an independent financial mechanism or "new and additional funding" to address L&D. Instead, it "urges" developed countries to scale up support and action, including finance for L&D. It further invites the Board of the Green Climate Fund (GCF) to continue to provide financial resources for L&D, along with adaptation and mitigation finance (UNFCCC 2019b). In one step forward, Santiago Network for Loss and Damage (SNLD) was established under the WIM to provide technical assistance for addressing L&D in vulnerable countries. The outcome also requests the ExCOM to revise the terms of reference for and launch an expert group on slow-onset events and non-economic losses (UNFCCC 2019b).

The political nature of international climate change L&D negotiations demonstrated once again in COP 25 has triggered ongoing calls for a meaningful international debate and more ambitious actions to address real experienced impacts within vulnerable countries (Wewerinke-Singh & Salili 2019). At COP 26, developing countries' proposal for L&D financial facility was rejected in favour of a three-year Glasgow Dialogue to discuss funding arrangements (Carty & Walsh 2022; Sharma-Khushal et al. 2022). At the recent COP 27 in Egypt, international finance for L&D was placed on the agenda for the first time. After more than thirty years of L&D negotiations, and intense pressure by developing countries and non-governmental organisations leading up to COP 27, Parties decided to establish a long-awaited new funding arrangement to respond to L&D and assist in mobilising new and additional resources. Nevertheless, who will pay for the fund and its operational arrangements has yet to be decided. To assist in this process, a transitional committee is to be established to provide operational recommendations for consideration for new funding arrangements and the fund by COP 28 (UNFCCC 2022). The establishment of a specific fund for L&D has marked an important point of progress and "an important step towards justice" (United Nations News 2022).

A new review of the WIM will not be held until 2024 but until then, it may remain unclear how enhanced action and support, including finance will reach the most vulnerable people. Therefore, the ongoing delay is seen by governments in LDCs as having direct effects on their people's livelihoods, cultures, food security, and general well-being, raising important diplomatic questions and concerns about climate justice. The following section explicitly discusses the importance of climate justice theory for this research followed by the relevance of adaptive cycle and social-ecological systems theory for understanding L&D and ways to avert, minimise, and address L&D in rural Indo-Fijian sugarcane communities.

2.3 Theoretical contribution

A theory is "a statement of concepts and their interrelationship that shows how and/or why a phenomenon occurs" (Corley & Gioia 2011, p. 12). To begin with, the theory of climate justice will be used to argue the importance of mobilising resources to vulnerable countries to enhance support and action to avert, minimise, and address L&D. Additionally, the adaptive cycle framework and social-ecological systems (SES) theory will be used describe the lived experiences of L&D in Indo-Fijian sugarcane communities and Fiji's sugar industry, the importance of preventing a systems collapse, and the need for transformational adaptation for the sustainability of Fiji's sugar industry. The following sections will explain the relevance and applicability of climate justice theory, adaptive cycle framework, and SES theory for this research.

2.3.1 Climate justice theory

The climate justice movement has deep roots in environmental justice movement (Long, Roberts & Dehm 2010). Initially, the focus of environmental justice was associated with inequitable distribution of environmental risks, ethnicity, income levels, and governmental protection (Schlosberg & Collins 2014). Over the decades, climate justice has gained momentum in public debates and grassroots campaigns where connections are made between human rights, uneven development, and climate change (Porter et al. 2020). According to Guyatt (2017, p. 2), climate justice is strongly linked to "human rights and development to achieve a human-centred approach whereby safeguarding the rights of the most vulnerable and sharing the burden and benefits of climate change and its resolution equitably and fairly." Preston et al. (2014, p. 3) believed that "climate justice is about ensuring, both collectively and individually, that we have the ability to prepare for, respond to, and recover from climate change impacts and the policies to adapt or mitigate to them by taking account of existing and projected vulnerabilities, resources and capabilities."

Climate justice theory is relevant for this research because it emphasises that the world's poor and the most vulnerable countries, who are unfairly affected by climate change, should have the right to access resources that meet their climate change needs. This is also the case in Fiji's sugar industry which is severely impacted by severe cyclones, drought, floods, and sea-level rise. Recovery and rehabilitation from such climatic impacts are beyond the Fijian government's national budget. In most cases, donation from the public and humanitarian aid is heavily relied on (Noy & Edmonds 2016). Despite only contributing less than 0.03 percent of total carbon emissions, the PICs are disproportionally affected by climatic impacts (Spencer et al. 2020; Thomas et al. 2020). A key argument in climate justice debate is the recognition that current and future climate impacts will be unevenly felt and disproportionately affect communities that are least capable of responding to climate risks. It is for this reason that PICs are at the forefront of climate justice debate. Even efforts to limit temperature increase to 1.5 °C above pre-industrial levels has the potential to devastate PICs (Falzon & Batur 2018). Clearly, international climate negotiations have failed to meet the need of the poorest and the most vulnerable countries (Falzon & Batur 2018).

International climate change negotiations began in 1992 at the Rio Earth Summit when the UNFCCC was established (Falzon & Batur 2018). Since the beginning of international climate change negotiations, there has been a divide between developed and developing countries (Wewerinke-Singh & Salili 2019). Interests of economically dominant countries are

prioritised as they have the necessary resources to confront climate change. Hence, developed countries control the direction of policy making (Falzon & Batur 2018). One exemplary case of the political divide is the Kyoto Protocol. The purpose of this international treaty was to bring about reduction in net global GHG emissions (Rowlands 2001) and to achieve "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC 1992, p. 4). The institutional failure of the Kyoto Protocol was a result of the United States, one of the largest polluters, who deliberately never ratified the Protocol (Falzon & Batur 2018). As a result, the Kyoto Protocol failed in even its minimal efforts to reduce global emissions (Rosen 2015).

Climate change is also seen to cause double vulnerability in developing countries where poverty, limited resources, inadequate infrastructure, and weak governance systems further increases vulnerability to climatic impacts (Colenbrander, Dodman & Mitlin 2018). In such locations, the threat-multiplying effects of climate change will further degrade human dignity and health systems due to their inability to cope (Scheffran et al. 2012). Many Pacific communities also live in the fear that they may lose their land, culture, and identity as the islands become uninhabitable due to climate change (Spencer et al. 2020; Zellentin 2015). Of growing concern is that recent research has explicitly recognised intolerable climate risks and L&D in vulnerable PICs (Charan, Kaur & Singh 2018; McNamara & Gibson 2009; Tabe 2019). Yet, institutional mechanism to address L&D under the UNFCCC is still vague.

As the negotiations under the UNFCCC have unfolded, power imbalances, and the political nature of discussions have pushed L&D off the UNFCCC agenda. The rich and developed countries have attempted to discredit and deny the very existence of L&D despite the developing countries providing evidence of L&D. This nature of negotiations have affected concrete outcomes for addressing L&D, including enhancing support and action on L&D in vulnerable countries (Nand & Bardsley 2020). More importantly, the WIM was established in 2013 to address L&D, yet to date, it has failed to deliver a financial arm to address L&D in vulnerable countries. Additionally, the Paris Agreement, under Article 9, only provides financial support for mitigation and adaptation efforts and does not provide evidence of financial support for activities related to L&D (Mace & Verheyen 2016; UNFCCC 2015a).

Moreover, climate change L&D has been a contentious issue due to being closely associated with liability and compensation (Gsottbauer et al. 2018). Acknowledgement of L&D by developed countries and establishing a liability component under the UNFCCC would hold developed countries legally and financially accountable for decades of high GHG emissions (Falzon & Batur 2018). Instead of being held accountable for addressing global climate change issue, the developed countries prefer to fund mitigation and adaptation efforts on a voluntary basis (Falzon & Batur 2018). Developed countries have emphasised insurance to address L&D, however, this is seen as a distraction from the real solution. With insurance, vulnerable people are required to pay insurance premiums whereas solidarity instruments transfer responsibility to the international community, taking into account polluter pay principle (Richards 2018). Additionally, insurance does not address L&D from slow-onset events and is not applicable to NELD (Richards & Schalatek, 2017).

This thesis supports the view that climate change is a political challenge. More pragmatic, innovative, and transformative climate action are urgently required to address the issue of L&D. Global leaders must strive for climate justice through global policy. However, this will only be possible if there is determined global commitment. In the case of Fiji's sugar industry, unjust harm due to cyclones and droughts and the resulting L&D represents a clear case of climate justice. Therefore, resources, particularly finance and innovative technology, must be provided by the developed countries to avoid current and future L&D in vulnerable countries such as Fiji.

2.3.2 Adaptive cycle: At a glance

C. S. Holling's eight-figure adaptive cycle is a powerful model for studying system dynamics and has four distinct phases; stages of growth/ exploitation (r), equilibrium/ conservation (K), collapse/ release (Ω), and reorientation/ reorganisation (α) (Figure 1) (Fath, Dean & Katzmair 2015). The subsequent sections will characterise each of the phases in the adaptive cycle (Figure 2.1).

The adaptive cycle is relevant to this research because it enables the researcher to consider how a system moves through each phase of the cycle which provides opportunities for growth, flexibility, learning from social memory and past experiences, the crucial role of leadership, innovation, and transformation. Similarly, these concepts will be applied to the sugar industry of Fiji, highlighting periods of collapse, emergent leadership, and the need for transformation. The following sections will detail each phase of the adaptive cycle.

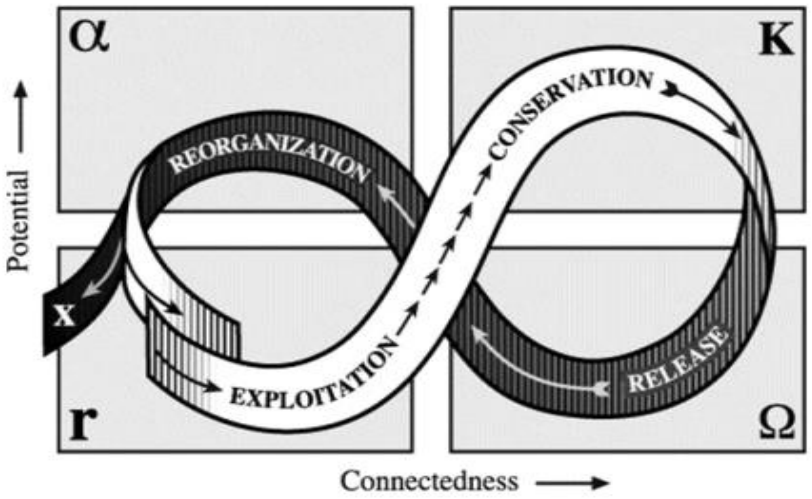

Figure 2.1 Adaptive cycle

In the growth (r) phase, the system has reorientated successfully initially after establishment or after a dramatic change. It seeks resources and information for growth. Poverty trap in the growth (r) phase blocks resources and information flow, inhibiting positive feedback that allows a system to grow. The growth phase is often marked by abundant resources, leadership, networks, and trust (Fath, Dean & Katzmair 2015). It is seen as removing obstacles, being organised, and leveraging resources such as social, financial, and intellectual capital to develop and adopt innovative solutions proposed in the previous stage (Moore et al. 2015).

The equilibrium (K) phase is marked by controlled development (rigidity trap). This phase represents the least flexibility and the least potential for change with high levels of vulnerability and low levels of resilience (Rosen & Rivera-Collazo 2012). In some cases, processes, policies, and emergence become so refined and rigid that there is no room for further evolution in the system which limits adaptation. Fewer resources are available for innovation. However, co-creation of networks, and information flow maintains high level of structure and organisation. The fore loop from growth phase (r) to equilibrium (K) represents incremental growth and accumulation of resources (Fath, Dean & Katzmair 2015).

At the top of the curve, the system is then seen to collapse (Ω). This is represented by the back loop (Fath, Dean & Katzmair 2015). The collapse of the system may be due to failure of traditional modes of environmental governance and social systems to tolerate uncertainty or adapt to changing environmental and social conditions (DeCaro et al. 2017) or due to crossing biophysical thresholds (Rockström et al. 2009). This phase is characterised by the need for new ideas, especially creative solutions, and emergent leadership but also high level of uncertainty and low resilience which slowly increases over time (Moore et al. 2015). In this phase, emergent leadership enhances learning and adaptive capacity to reorientate a system successfully through the cycle in the future. Failure to survive the collapse of a system results in complete breakdown of the system (Fath, Dean & Katzmair 2015).

The reorientation phase of the adaptive cycle is the phase with highest uncertainty but with greatest resilience, highest adaptability, and innovation. The system is seen to self-reorientate or self-reorganise after a crisis and access resources (natural, human, social, and economic) that were stored prior to the crisis (Fath, Dean & Katzmair 2015). Drawing on traditional solutions, social memory, and past experiences assist to fight against cultural collapse (Rosen & Rivera-Collazo 2012). Science, religion and other like-minded networks reorganise and emerge after a disaster and keep moving their values and beliefs forward (Pelling & Manuel-Navarrete 2011). This provides a "window of opportunity" (DeCaro et al. 2017) and the interaction between these emergent groups provide a platform for dynamic development (Coetzee, Van Niekerk & Raju 2016).

While Holling's adaptive cycle has been traditionally applied to ecology, the model has also been applied more broadly within other complex adaptive systems (CAS) for managing resilience (Fath, Dean & Katzmair 2015). CAS is defined as systems that have one or more levels of feedback, exhibit emergent properties, self-organisation, and produce non-linear dynamic behaviour (Carmichael & Hadžikadić 2019). Social-ecological systems (SESs) are an example of CAS where multiple social and ecological components interact with each other in space and time and respond to dynamic external and internal changes whereby the SES evolves and adapts to these changes (Maldonado et al. 2020).

2.3.3 Social-ecological systems theory

According to Colding & Barthel (2019), SES was first coined in 1970 and the first definition of SES was proposed by Russian microbiologist B. L. Cherkasskii in 1988. A decade later, Berkes and Folke turned the SES concept into a framework for studying the interrelated nature of social and ecological systems (Berkes & Folke 1998). Folke (2007, p. 14) noted that "social and ecological systems are deeply interconnected and co-evolving across spatial and temporal scales." SES theory emphasises that the long-term health of social and ecological systems depends upon change, including periods of growth, collapse, and reorganisation

(Pelling 2011). Social systems refer to human dimensions including economic, political, and cultural dimensions. Berkes, Colding & Folke (2001) further stated that social systems are concerned with governance (property right institution and access to resources), systems of knowledge, world views, and ethics. On the other hand, ecological systems refer to self-regulating communities of organisms interacting with one another and their environment (Berkes, Colding & Folke 2001; Folke et al. 2016). Additionally, a crucial component of SESs are feedback mechanisms that improve the resilience of SESs over time (Berkes & Folke 1998).

Social and ecological components in SES are interdependent. Therefore, it becomes increasingly challenging to understand ecosystems without accounting for human dimensions. By trying to understand ecology first and then adding the social dimension or vice versa, creates missed opportunities and constraints essential feedback of SES (Folke 2007). Folke (2007) emphasised that a majority of studies in the past have focused on the social dimension only, treating ecosystems as a "black box", assuming that if the social system performs adaptively or is well organised, it will also manage ecosystems sustainably. Although human systems can adapt as required, such adaptation may come at the expense of changes in the capacity of ecosystems to sustain these adaptation and may generate traps and breakpoints in the resilience of SESs (Folke 2006, 2007).

The SES approach is relevant for this study because it aims to identify multiple stressors which enhance SES vulnerability, climate impacts and L&D, adaptation constriants and limits, and adaptation needs for sustainability of Fiji's sugar industry. SES theory also examines the interaction between human and ecological sub-systems as well as access to resources which is relevant to examine L&D governance in the Fijian sugar industry. In the following sections, the relevance of SES for this study is highlighted.

2.3.4 Social-ecological systems theory and vulnerability

IPCC (2014a) defined vulnerability as elements of sensitivity or susceptibility to harm and the lack of capacity to cope and adapt. According to IPCC (2012), exposure refers to presence of people, livelihoods, and assets in a location that could be adversely affected. Sensitivity refers to organisation and structure of a system that determines the degree to which it is affected or responsive to an exposure (Pearce et al. 2018). Adaptive capacity refers to the combination of strength, attributes, and resources available to prepare for and undertake actions to reduce adverse impacts, moderate harm, and exploit beneficial opportunities (IPCC 2012).

Pearce et al. (2018) drawing on Smit & Wandel (2006), IPCC (2007, 2014), and McCubbin, Smit & Pearce (2015) conceptualised vulnerability as a function of exposure to bio-physical events, sensitivity to these exposures, and the adaptive capacity to deal with these exposure-sensitivities. The same framework has been used in other climate change vulnerability studies in Fiji (Currenti et al. 2019; Shabina et al. 2021) and will be applied in this thesis to frame the discussion. Pearce et al. (2018) building on Smit & Wandel (2006) emphasised that the manner in which individuals, social groups, and communities experience and respond to climatic stressors will be influenced by a range of broader social, ecological, economic, political, and ecological conditions that are distinctive to a particular place and time.

Folke (2007) emphasised that to understand current and future SES vulnerability, it is important to consider both ecological and social dimensions. Attempting to understand any of

these components without consideration of the other will impede important feedback necessary for maintaining resilience of SES (Folke 2007). As demonstrated by Lauerburg et al. (2020), sub-systems (ecological, economic, and socio-cultural vulnerability) in SES are interlinked. Lauerburg et al. (2020) firmly believed that vulnerability and tipping point of SES can have cascading impacts and lead to collapse of a system. The presence of tipping point in one sub-system affects its vulnerability. As a result, changes in vulnerability in one sub-system has a cascading effect and leads to changes in vulnerability in adjacent sub-systems due to interlinked feedback mechanisms.

The changes in vulnerability and presence of tipping points alters SES in unpredictable ways and affects the sustainability of the system. Consequently, a degraded SES becomes more vulnerable and susceptible to harm. For example, a degraded ecosystem loses its capacity to buffer local communities against hazards, increasing exposure of SES. On the other hand, a well-managed ecosystem and its regulating services can reduce risks (Depietri 2020). As a result, Webb et al. (2017) highlighted that feedback mechanisms, climate change, and adaptive capacity need to be prioritised to identify vulnerable systems and appropriate adaptation actions.

Therefore, consideration of multiple dimensions and factors of vulnerability and understanding current and future SES vulnerability is crucial for designing disaster preparedness and adaptation strategies to reduce climatic risks (IPCC 2014b). More importantly, research on stakeholders' perspectives on vulnerability and adaptation options can provide a meaningful insight into mobilising and enhancing support and action, including finance for vulnerable communities that are already experiencing L&D (Chandra & Gaganis 2016).

2.3.5 Social-ecological systems theory and adaptive governace

Recently, SES theory has been used as a policy tool for social-ecological management under adaptive governance (Cote & Nightingale 2012). Adaptive governance represents a set of diverse stakeholders operating at various social and ecological levels in multi-level institutions and organisations (Folke 2006). To confront rapid change and uncertainty in complex SES, adaptive governance represents a series of structures and processes that allow transitions of any existing environmental regime towards a more flexible regime (Chaffin & Gunderson 2016). Dynamic social networks and cooperation are essential features of adaptive governance, allowing for social learning through trust and cooperation (Folke 2007; Gunderson 2001). Social learning describes pathways and social relationships that have the potential to shape information exchange that could lead to new ways of acting or thinking (Pelling 2011).

Figure 2 indicates two sets of adaptive governance in SES (DeCaro et al. 2017). One that arises during and after a crisis (small-scale interaction, indicated by the red box) and the other that includes more formal rules, processes, and structures (indicated by the green box). As shown in Figure 2, rigid structures and unsupportive legislation that resists systematic changes can be an obstacle to adaptive governance and may trigger a system to collapse (DeCaro et al. 2017). At the same time, a crisis or collapse of a system could also be seen as a social catalyst for driving transformation (Folke 2006; Pelling & Manuel-Navarrete 2011). Consequently, a window of opportunity arises for adaptive governance to recognise the need

for systematic changes, such as new legislation and emergent leadership which would successfully guide the SES through the adaptive process.

Emergent leaders set the stage for learning, adaptive capacity, and reorientation of a resilient system successfully through the adaptive cycle (Fath, Dean & Katzmair 2015). Adaptive capacity in social systems refers to engaging in an iterative learning process whereby generating knowledge and problem-solving skills and the ability of institutions to balance power (Bronen 2015). The capacity to adapt relies on many factors such as access to technologies, economic resources, knowledge, information and skills, risk perception, the degree of equity in the society, and governance (Barnett & Campbell 2010).

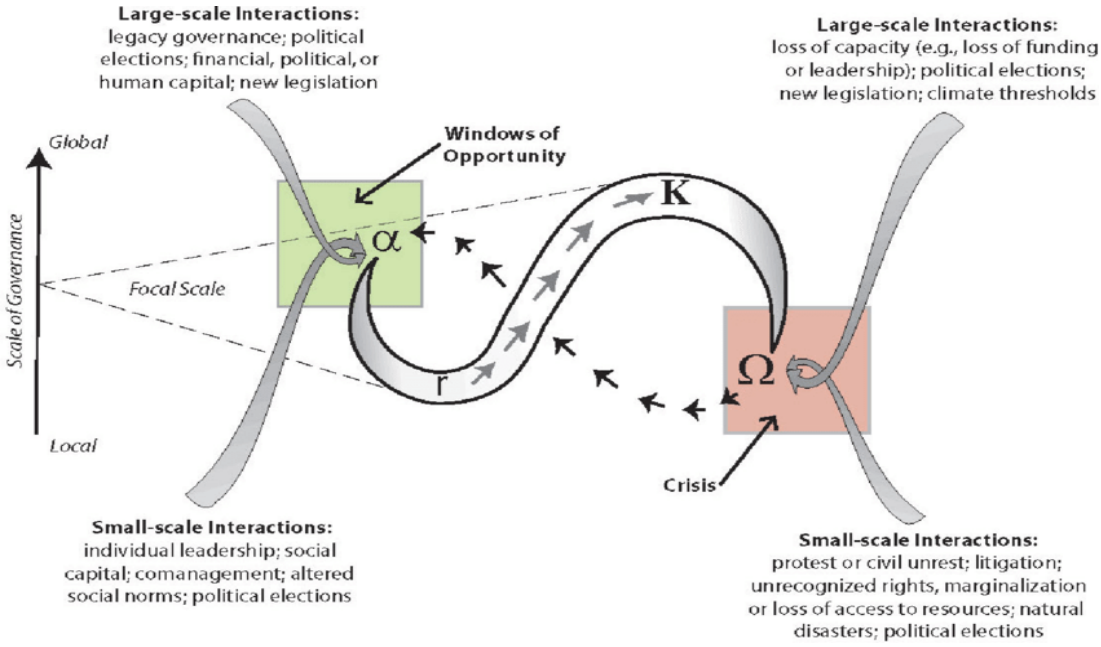

Figure 2.2 Adaptive governance cycle

This thesis will apply SES theory and adaptive governance perspective to examine L&D governance and institutional challenges to avert, minimise, and address L&D in Fiji's sugar industry. By using adaptive governance, this thesis will emphasise what opportunities exist for enhancing adaptive capacity, policy and institutional reforms, and how emergent leadership can assist in mitigating climatic risks in rural and remote agricultural communities.

2.3.6 Social-ecological systems theory and transformational adaptation

Different scholars have presented different conceptualisation of adaptation (IPCC 2014; Moser & Ekstrom 2010; Morrison 2021; Rickards & Howden 2012). Climate adaptation in SES is "the adjustment process to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC 2014, p. 118). According to adaptation scholarship, adaptation action can range from short-term coping to longer-term transformative measures (Iese et al. 2020; Jakku et al. 2016; Moser & Ekstrom 2010).

An agricultural adaptation framework put forward by Rickards & Howden (2012) provided a novel and integrative framework for understanding climate change adaptation in agriculture. Rickards & Howden (2012) referred to three distinct types of adaptation - incremental adaptation, systems adaptation, and transformational adaptation, and this range is utilised to frame the discussion here. As discussed below, Rickards & Howden (2012) further explained how implementation of these various levels of adaptation measures affect SES under changing climate.

Coping strategies are considered short-term responses such as reducing food consumption which are aimed at dealing with, or even surviving sudden events (van der Geest & Warner 2015; Yaffa 2013). IPCC (2022, p. 2904) clearly defines coping as "the use of available skills, resources and opportunities to address, manage and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organisations and systems in the short to medium term." Incremental adaptation refers to adjustments in SES where the system remains on a pre-existing trajectory that enables a system to maintain its key elements and processes while adjusting to changes within the environment (Deubelli & Mechler 2021; Dharmasiri & Jayarathne 2021; Hadarits et al. 2017; Manuel-Navarrete & Pelling 2015; Vermeulen et al. 2018). Therefore, coping and incremental adaptation has short-term benefits but often fails to address the underlying or root causes of SES vulnerability (Matyas & Pelling 2015; Termeer, Dewulf & Biesbroek 2017; Webb et al. 2017).

In agreement, Fedele et al. (2019) and Fedele et al. (2020) emphasised that most responses to climate change impacts include coping and incremental responses that are used to maintain the SES and had limited success in improving the *status quo.* Many scholars argue that incremental adjustments risk continuation of unsustainable practices under change climate (Few et al. 2017; Kates, Travis & Wilbanks 2012; Rickards & Howden 2012; Park et al. 2012). Examples of incremental adaptation or adjustments within agro-ecosystems include changes in practices or technologies within an existing system such as in planting times, the introduction of irrigation technologies, and nutrient management (Hadarits et al. 2017; Pelling, O'Brien & Matyas 2015; Rickards & Howden 2012).

Systems adaptation ensures some degree of fundamental change to an existing system in response to climate change (Dowd et al. 2014). Systems adaptation such as livelihood diversification and maintaining or regenerating diversity could offer a transitional path to transformational adaptation and ultimately transform the SES (Iese et al. 2020). Other examples of systems adaptation include the evolution of climate-sensitive precision agriculture and the breeding and introduction of climate-resilient crops (Iese et al. 2020; Rickards & Howden 2012). Systems adaptation could offer a transitional path to transformational adaptation and ultimately lead to SES been transformed (Iese et al. 2020; Rickards & Howden 2012; Morrison 2021).

Transformational adaptation is regarded as a radical change in the SES that entails a series of phases from incremental to transformational adaptation (Deubelli & Mechler 2021; Jakku et al. 2016). Transformational adaptation includes new products such as ecosystem services and transformation in land use (Rickards & Howden, 2012). Rickards & Howden (2012) and (Deubelli & Mechler 2021) also emphasised that transformational adaptation does not exist in a vacuum and the three types of adaptation overlap conceptually and in practice. Therefore,

adaptation is a continuous process through which individuals, communities, and countries seek to adapt to changing climate (Deubelli & Mechler 2021; Dharmasiri & Jayarathne 2021).

In SES, transformation is regarded as the ability to create a fundamentally new system (Pahl-wostl 2012) or fundamental change in values, identity, or structures (Colloff et al. 2021; Manuel-Navarrete & Pelling 2015). Some transformations are unintentional and result from SES's ability to reorganise after a crisis or collapse (Manuel-Navarrete & Pelling 2015). Whether unintentional or intentional, strategic shifts are necessary and frequently needed to respond to new information and changing conditions (Park et al. 2012; Rickards 2013) and address underlying vulnerabilities that perpetuate risk (O'Brien 2012; Pelling 2011). Due to the shifts in SES caused by climate change, forward-looking and transformational adaptation would be necessary in SES to address current and future root causes of vulnerability and to redirect the system towards improved social-ecological conditions (Boon et al. 2021; Fedele et al. 2020; Morrison, Nand & Lal 2019).

Yet, in vulnerable communities, the absence of new adaptation measures and the unavailability of resources limits effective transformations and generates inevitable climatic risks. According to McCubbin, Smit & Pearce (2015), the absence of appropriate adaptation measures or bearing the effects of a stressor is a response employed for conditions people view as inevitable. Therefore, people attempt to do nothing, live with the risks, and accept losses (Dow et al. 2013).

This thesis will use adaptation framework presented by Rickards & Howden (2012) to examine adaptation measures implemented in Fiji's sugar industry. By systematically identifying various levels of adaptation measures undertaken in Fiji's sugar industry, this thesis aims to advance our understanding of adaptation practices, adaptation limits and constraints, resulting L&D, and opportunities for transformational adaptation to mitigate climatic risks and L&D.

2.4 Framing climate change loss and damage

Under an increasing degree of climate change, climatic risks threaten to accelerate losses in the social and ecological domain (Barnett et al. 2016). Yet, the concept of loss is poorly theorised and the methods to capture losses are also limited and rarely applied (Barnett et al. 2016). Owing to a lack of clear and internationally agreed definition by the UNFCCC, different conceptualisations of L&D have emerged for policymakers and for guiding research and knowledge development. This section focuses on the various framings of L&D proposed by different scholars and what this could mean for future L&D discussions.

In a pioneering L&D study in vulnerable countries, van der Geest & Warner (2015) proposed a conceptual framework that linked L&D to vulnerability, risks, coping, and adaptation. van der Geest & Warner (2015) emphasised that at the local level, households implement risk reduction, coping, and adaptation measures to prevent L&D. However, inadequate adaptation and adaptation constraints resulted in unavoidable L&D. The authors used a multi-dimensional vulnerability index to study the implementation of coping measures between more and less vulnerable households. The framework demonstrated that collective vulnerability and household vulnerability shape household livelihood strategies. The household vulnerability profile determines the impacts faced by the household. If the household experiences no impacts, no L&D occurs. If the household is impacted, depending

on the coping and adaptation measures implemented, the household may incur L&D. Also, a feedback loop connects L&D back to household's vulnerability profile (Figure 2.3).

In another study, Warner & van der Geest (2013) proposed four main L&D pathways: (i) existing coping and adaptation strategies are not enough, (ii) measures include costs that cannot be regained, (iii) measures have short-term merits but tend to have adverse impacts in the long-term (survive in short-term but weaken household resilience in longer-term), and (iv) finally no measures are possible or adopted. In cases where no measures are possible, people may accept L&D or undertake more significant transformational changes such as migration and relocation. Undertaking transformational changes strongly suggested that communities are already approaching biophysical and social boundaries of adaptation affecting the sustainability and functionality of communities (Dow et al. 2013; Preston, Dow & Berkhout 2013).

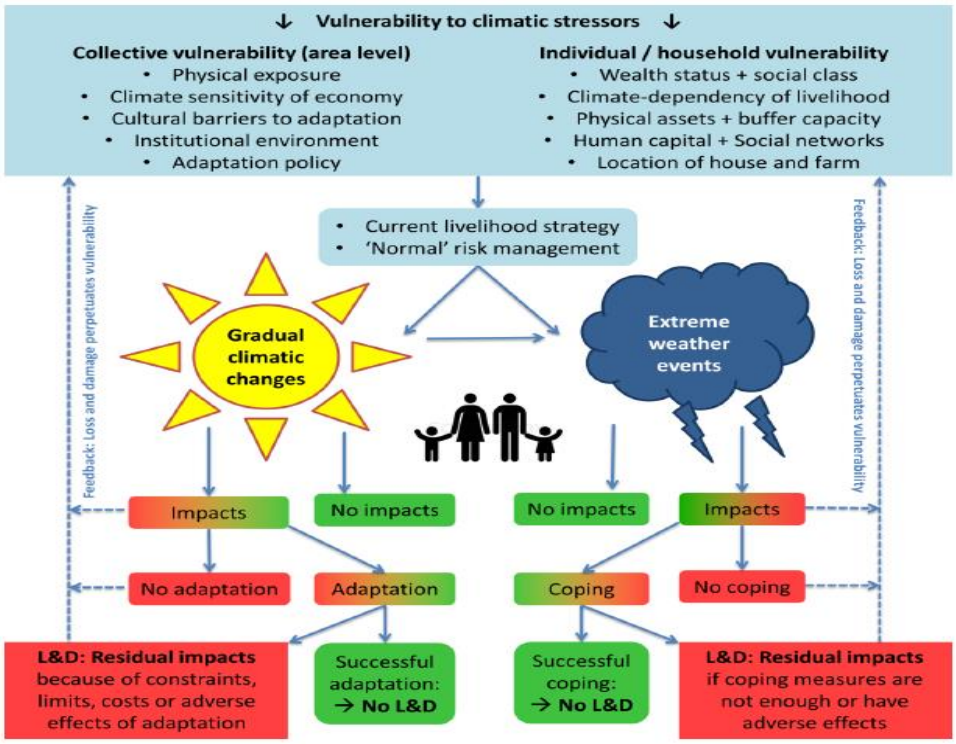

Figure 2.3 Conceptual framework linking L&D to adaptation, vulnerability and risk management

Verheyen & Roderick (2008) and van der Geest & Warner (2015) described crucial policy-relevant distinctions between three categories of L&D referred to as avoided, unavoided, and unavoidable. The avoided category of L&D refers to impacts and risks that can and will be avoided by mitigation and adaptation measures. L&D in the unavoided category refers to risks that could have been avoided through adequate mitigation and adaptation measures but these strategies were not implemented due to financial and technical constraints. Unavoidable L&D cannot be avoided through further mitigation and adaptation measures because social and ecological thresholds have been reached. Consequently, mechanisms for averting, minimising and addressing L&D in SES must be prioritised to mitigate future L&D and prevent cascading effects.

Furthermore, Boyd et al. (2017) suggested four different typologies of L&D. The four typologies include: (i) adaptation and mitigation perspective, (ii) risk management perspective, (iii) limits to adaptation perspective, and (iv) existential perspective. Efforts required in (i) suggest a prevention approach, that is, the adaptation and mitigation perspective present the viewpoint that existing efforts for adaptation and mitigation will be sufficient to prevent L&D. The risk management perspective states that discussions around L&D should focus on linking and building on existing efforts under disaster risk reduction (DRR), climate change adaptation (CCA), and humanitarian work. Limits to adaptation perspective focuses on residual L&D beyond adaptation and mitigation. Existential perspective focuses on addressing inevitable harm to communities, ecosystems, and cultures due to climate change. The emphasis here is placed on international liability, compensation, and the need for new institutional mechanisms that are separate from adaptation and mitigation.

Moreover, Page & Heyward (2017, p. 358) defined L&D as "unjustified disruptions in the lives of individuals and communities whether permanent or otherwise that are attributed to anthropogenic climate change and which remain after mitigation and adaptation efforts have been attempted." This definition is primarily based on three principles: (i) mitigation and adaptation efforts have not prevented climate change impacts giving rise to L&D, (ii) future sets of L&D impacts cannot be prevented by mitigation efforts due to slow-onset climate change impacts that are "locked in", and (iii) only some climate change impacts that cannot be prevented by mitigation are amenable to adaptation policies. This is because behavioural and institutional adjustment is highly constrained in communities that are dependable on ecosystem services or have limited capacity to respond to disasters and will be the first ones to experience extreme changes in climate. Similar to the definition provided by Page & Heyward (2017), Mace & Verheyen (2016) and Wallimann-Helmer et al. (2018, p. 41) recognised L&D as separate from mitigation and adaptation by referring to L&D as "actions dealing with residual, adverse impacts of climate change that remain after adaptation and mitigation measures have been adopted."

2.5 Evidence of climate change loss and damage

Several L&D studies in vulnerable countries have demonstrated the impacts of climate change, limits to coping and adaptation, and the resulting L&D (McNamara, Westoby & Chandra 2021; Monnereau & Abraham 2013; van der Geest & Warner 2015; Warner & van der Geest 2013; Yaffa 2013). In their review, van der Geest & Warner (2015) argued that 69 percent of the impacts from climate stressors are beyond the coping capacity of households in vulnerable countries. The authors examined L&D coping measures of less vulnerable and more vulnerable households (n=1431) in four African and Asian countries (Bangladesh, Gambia, Kenya, and Nepal) with impact of climatic stressors (drought, floods, and cyclones). The study highlighted that the higher the multi-dimensional vulnerability index (MDVI), the greater the household's vulnerability, and the more likely a household would suffer climate-related L&D. Over 95 percent of the households surveyed had implemented one coping measure. Majority (90 percent) of the household implemented at least three to five coping measures, including modifying food consumption, reducing expenses, and relying on social networks. However, 69 percent of households experienced L&D from climatic events as their coping measures were insufficient, costly, or erosive, impacting their livelihood, household food production, assets, and culture.

In another study, Warner & van der Geest (2013), using a mixed method approach, investigated L&D incurred by households in nine vulnerable countries (Bangladesh, Bhutan, Burkina Faso, Ethiopia, the Gambia, Kenya, Micronesia, Mozambique and Nepal) based on interactions between climate variability and other factors such as livelihood, health, and social/physical assets. The study highlighted that coping measures implemented in response to drought and floods included relying on aid, seeking employment, relying on social networks, selling assets, relocation, and modifying food consumption. Adaptation measures implemented in response to slow-onset events included planting resilient varieties, water-sharing arrangements, and building seawalls. Despite implementing coping and adaptation measures, majority households confirmed that existing coping and adaptation strategies were insufficient to prevent L&D. The study emphasised that vulnerable countries are already experiencing limits of adaptation which will impede sustainable development.

Monnereau & Abraham (2013), using a qualitative approach, examined the vulnerability of households on the island of Kosrae, Federated States of Micronesia, to coastal erosion. The study revealed that the intensification of sea-level rise has further worsened coastal erosion. Households implemented measures such as building seawalls, landfilling, tree planting along the coastline, and increasing elevation of houses. Regardless, majority of these households still incurred L&D to livelihood, housing, and culture. Coastal erosion also affected burial grounds, as loved ones are buried next to houses. The study stressed that limitation to adaptation was noted due to financial limits, lack of knowledge, and lack of skills.

Yaffa (2013) studied the impacts of 2011 severe drought on agricultural households, their coping measures, and the resulting L&D in the North Bank Region of the Gambia. Most respondents suggested severe impacts, while some faced moderate impacts. Drought severely affected crops, such as groundnut, maize, millet and rice paddy, livestock, tree crops, and fishing activities. Respondents also faced food shortages which led to higher food prices, making coping more difficult. Coping strategies implemented by households included livelihood diversification, selling livestock, relying on social networks for aid, cutting down on expenses, and less food consumption. Migration was seen as one of the least common coping mechanisms. Most households confirmed that coping measures were insufficient to avoid negative effects leading to L&D. Furthermore, in agricultural communities, the risk of L&D increases with lack of investment in water-related infrastructure, agricultural technology, and health care services (van der Geest et al. 2019b). This study is consistent with the key findings of Warner & van der Geest (2013) highlighting that existing coping and adaptation to biophysical impact is not enough.

Recent systematic review on intangible L&D by Tschakert et al. (2019) demonstrated one thousand ways to experience losses over one hundred case studies from around the world. The losses ranged from loss of culture and tradition, physical and mental health, sense of place, and identity among others. McNamara, Westoby & Chandra (2021) also conducted a systemic review to understand what is already known about NELD in the PICs. The study concluded that NELD included loss of culture, displacement, degradation of ecosystem services, and loss of health and well-being. In another study, McNamara et al. (2021) identified eight interconnected and core dimensions of NELD which included health and well-being, ways of being, future ways of being, cultural sites and sacred places, indigenous knowledge, biodiversity and ecosystems, life-sustaining tools, and connection to land and sea.

Recent literature also recognises that L&D, including NELD, can deteriorate psychological and emotional well-being (McNamara, Westoby & Chandra 2021; Magee et al. 2016; Tschakert, Ellis, Anderson, et al. 2019). Deteriorating psychological and emotional well-being, including fear, post-traumatic stress, sadness, grief, anxiety, and depression when unaddressed could remain for many years and act as a barrier for implementing successful future adaptation measures (Magee et al. 2016; Sattler et al. 2018). Apart from economic and non-economic losses, cascading impacts such as food insecurity risks, disruption to education, deteriorating ecosystem services, biodiversity loss, and loss of culture emphasise how L&D diminishes well-being of vulnerable communities and threatens SES sustainability (Cámara-Leret et al. 2019; Chandra et al. 2017; Thomas et al. 2018).

Many scholars have also argued that L&D is a result of differentiated vulnerability (Barnett et al. 2016; Boyd et al. 2021; Chandra et al. 2017). Barnett et al. (2016) and Chandra et al. (2017) emphasised that losses arising from climate change is experienced differently across different groups. For example, women are highly vulnerable to climate change events and disproportionately suffer severe L&D (Clissold, Westoby & McNamara 2020; Chandra et al. 2017; McNamara, Clissold & Westoby 2020; Thomas et al. 2018). Therefore, discussions on L&D provide an opportunity to critically reflect on irreversible L&D and root causes of SES vulnerability (Boyd et al. 2021) such as broader social, economic, cultural, and political processes occurring at various scales. These processes or drivers of vulnerability must be recognised to drive transformational adaptation to avert, minimise, and address L&D.

Overall, adaptation measures documented in L&D studies emphasise that current adaptation measures are inadequate to prevent L&D (McNamara et al. 2021; Thomas et al. 2018; Warner & van der Geest 2013; Yaffa 2013). With projected climate change, and likelihood of impacts worsening, there is an urgency to address L&D more coherently. The Intergovernmental Panel on Climate Change (IPCC) 1.5 ℃ Special Report indicated that for Small Island Developing States (SIDS) observed and projected risks have severe consequences for SES. The IPCC 1.5 ℃ Special Report highlighted that even if the increase in global average temperature is limited to 2 ℃ above pre-industrial levels, climate change impacts and losses would still be unavoidable (IPCC 2018). The Working Group II contribution to the IPCC Sixth Assessment Report on Impacts, Adaptation, and Vulnerability reported that adverse climate change impacts and L&D disproportionately affect vulnerable communities with irreversible impacts (IPCC 2022). While resources to avert, minimise, and address L&D in vulnerable countries are urgently required, the WIM has been unable to mobilise the much-needed support and action, including finance. The section below discusses current outcomes from UNFCCC for addressing L&D in vulnerable countries. These measures include comprehensive risk management and climate finance.

2.6 Addressing climate change loss and damage in vulnerable countries

Under changing climatic conditions, adaptation needs and L&D in vulnerable countries will escalate (Nhamo & Nhamo 2016; Schaeffer et al. 2015; UNEP 2018). For example, L&D costs for developing countries are estimated to be around US$400 billion by 2030, rising to US$1-2 trillion by 2050 (Baarsch et al. 2015). As vulnerable countries continue to be disproportionately affected by climate change L&D, urgent support and action, including finance and technical assistance, are required by the vulnerable countries to avert, minimise, and address L&D. At the international level, the WIM and SNLD have the responsibility to

assist vulnerable countries to avert, minimise, and address L&D (UNFCCC 2018c). Regardless, the WIM and SNLD are not fully operational and the current support and action provided are inadequate to avert, minimise, and address L&D. The section below discusses the options available to vulnerable countries to address L&D, including climate risk management (CRM), comprehensive risk management, and climate financing options.

2.6.1 Loss and damage and climate risk management

The WIM's first mandate seeks to enhance knowledge and understanding of CRM approaches to address L&D associated with adverse impacts of climate change, including slow-onset events (UNFCCC 2014). Despite ongoing climate policy efforts, countries will still face residual L&D under all plausible climate scenarios. To efficiently respond to the entire spectrum of risks, innovative measures must be implemented to avert, minimise, and address L&D. The Sendai Framework 2015-2030 also articulates on enhancing understanding of disaster risk in all dimensions and aims to guide multi-hazards management of disaster risks in development at all levels and across all sectors (United Nations Office for Disaster Risk Reduction 2015).

CRM is a crucial component of the WIM and has played an important role in climate policy and science (Mechler et al. 2014). The overall focus of CRM is to mitigate, avoid, prevent, and consider innovative financial mechanisms for risks (Mechler & Schinko 2016; Roberts & Pelling 2018). The CRM focuses on a combination of integrative, participatory, and iterative solutions to manage risks that support decision-making that is targeted for forward planning (GIZ 2015). This approach considers risk as a compound effect of hazard, socio-economic vulnerability, exposure, risk probability and perception, adaptive capacity, and the uncertainties and complexities in socio-ecological systems (IPCC 2014; Kelman 2018).

The CRM approach builds its expertise from the field of DRR which is focused on sudden events and CCA which is focused on slow-onset events (Mechler & Schinko 2016). Schinko & Mechler (2017) firmly believed that integrating DRR and CCA would support curative measures that can mitigate unavoidable risks and offer transformative risk management. Schinko, Mechler & Hochrainer-Stigler (2019) affirmed that the CRM should comprise of incremental, fundamental, and transformative interventions. Schinko & Mechler (2017) also argued that a CRM framework that includes L&D could initiate the operationalisation of the WIM and avoid delays and disagreements in the political process. While the CRM space aims to reduce risks, some risks are already locked-in which have serious cost implications for vulnerable communities. Relying on national resources has not reduced risks in these vulnerable countries. Overall, these risks are projected to increase in the near future along with an increase in challenges and costs of implementing risk reduction measures (Mechler & Schinko 2016).

At the local level, CRM uses climate risk assessment method to identify risks and its impact on people and ecosystems. Climate risk assessment has the ability to demonstrate how extreme events and slow-onset events interact with socio-economic factors and have an overall impact on the population and the ecosystem (Schinko, Mechler & Hochrainer-Stigler 2019). The risk assessment methodology follows a series of steps from categorising, assessing, and projecting impacts of events over a range of timescales and includes direct and indirect losses, loss of lives, and damages, and risk management options (GIZ 2015; Surminski & Lopez 2014).

Additionally, the CRM also needs to be integrated into new and existing institutional development plans, policies, and budgeting processes at all levels and all sectors (GIZ 2015). Schinko, Mechler & Hochrainer-Stigler (2017) claimed that co-developing CRM with national-level decision-makers can serve as a framework to address current adaptation deficits and uncertainties associated with climatic impacts and L&D. This approach will move L&D from a reactive standpoint to a more proactive position.

2.6.2 Comprehensive risk management capacity with risk transfer, risk pooling, and insurance

Risk transfer, including insurance, micro-insurance, micro-finance, and risk pooling can significantly reduce the financial burden of climatic impacts (Roberts & Pelling 2018). To strengthen and facilitate efforts for developing and implementing risk strategies, at COP 21, Parties requested the WIM's ExCom to establish a clearing house for risk transfer (UNFCCC 2016a). As a result, under Fiji's presidency at COP 23, the Fiji Clearing House for Risk Transfer was developed. The Fiji Clearing House for Risk Transfer serves as the repository of information on insurance and risk transfer, including case studies and RISK TALK which is an interactive tool for knowledge sharing on risk. To be effective in addressing L&D, the Fiji Clearing House for Risk Transfer needs to provide accurate information driven by demand and based on CRM needs. In accordance with the WIM, the Fiji Clearing House for Risk Transfer has three main aims which are to (i) enhance understanding, (ii) improve policy coherence, and (iii) enhance action and support (UNFCCC 2016b). However, there is uncertainty whether the clearing house for risk transfer is sufficient to address L&D in the absence of international finance (Pekkarinen, Toussaint & van Asselt 2019).

Another form of CRM is risk pooling. Risk pooling allows aggregation of risk over large geographical areas. The occurrence of severe climate-related L&D in certain locations may be offset by lower costs in other areas, allowing vulnerable countries to benefit from lowered premiums. An example of one such mechanism is the African Risk Capacity facility. However, such mechanisms are not utilised by poor developing countries. On average, only 2 percent of total losses related to weather-related events are insured. With the recognition of this gap, it was proposed that the WIM ExCom establish a clearing house for risk transfer to improve risk management (Mace & Verheyen 2016). Some of the drawbacks of risk pooling mechanism include highly vulnerable and developing countries paying their own premium, insufficient payouts to address L&D, and the sustainability of such mechanisms. There are also arguments that such mechanisms may encourage development in vulnerable areas and may be unable to pursue risk reduction efforts (Gewirtzman et al. 2018).

Many initiatives have been set up to support insurance pool schemes. These include InsuResilience Global Partnership, The Global Risk Financing Facility, and the UK Centre for Global Disaster Protection (Richards 2018). Insurance in the PICs is very limited with majority people having no coverage. Subsequently, the idea of a regional insurance pool was raised, leading to the establishment of the Pacific Catastrophe Risk Assessment and Insurance Initiative (PCRAFI) in the Pacific region. The PCARFI aims to increase the understanding of hazards and also provides funds to governments in times of a disaster. However, the funds are negligible, and without donor and private sector engagement, private insurance remains expensive for governments and households in vulnerable countries (Handmer & Nalau 2019; Pekkarinen, Toussaint & van Asselt 2019). If deprived of donor support, governments of

vulnerable countries may have to divert capital from existing budget allocations, further putting immerse pressure on limited resources.

While insurance may provide finance for emergency situations, it is not a source of climate finance and does not address L&D comprehensively. Insurance places the responsibility directly on the population at risk expecting them to purchase a premium. Clearly, this is not a fair approach as the cost of dealing with climate change rests on the governments and individuals in vulnerable countries who have least contributed to anthropogenic climate change. Therefore, insurance is a way to transfer responsibility from the big emitters to the poor population at risk. Künzel et al. (2017) argued that even though CRM and insurance provide liquidity after a disaster, these funds are still inadequate and SIDS still have limited access to international climate finance for addressing L&D.

Finally, the CRM and risk transfer tools may address sudden events but may not be sufficient to address slow-onset events. Hence, inclusion of curative measures for redress and rehabilitation is required. Roberts & Weikmans (2017) also believed that insurance is only feasible for low probability and high severity events. Insurance for more frequent events, non-economic L&D, and slow-onset events is not possible (Durand et al. 2016; Pekkarinen, Toussaint & van Asselt 2019). As a result, provision of adequate climate finance for addressing L&D in vulnerable countries is necessary.

2.6.3 Climate finance under the UNFCCC

Climate finance has been one of the key areas for negotiations as well as a source of tension between developed and developing countries (Gomez-Echeverri 2013). The WIM's third mandate seeks to enhance action and support, including finance. Yet, to date, there has been a lack of vision regarding L&D finance (Pekkarinen, Toussaint & van Asselt 2019). This is partly due to the political nature of L&D discussions under the UNFCCC and the fact that the call for L&D finance by the developing countries have been met by objections from the developed countries. Even when the Suva Expert Dialogue was organised to discuss L&D finance, it was evident that most of the discussions focused on the role of insurance for addressing L&D while neglecting discussions on L&D finance (UNFCCC 2018d).

According to the UNFCCC (2015b, p. 15), "developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention." The UNFCCC aims to fulfil the financial obligation of the developed countries to support the developing countries in achieving their climate action under the UNFCCC and the Paris Agreement. This financing should support the priorities of the developing countries and assist in implementing country-owned plans and strategies relevant for climate action as indicated under the National Determined Contributors, National Adaptation Programme of Action, and National Adaptation Plan (Richards & Schalatek 2017).

Under the Copenhagen Accord, the developed Parties had agreed to raise US$30 million during the 2010-2012 timeframe and also mobilise "new and additional" US$100 billion per year funds by 2020 to help the developing countries address climate change mitigation and adaptation (Bodansky 2010). The developed countries have pledged to provide new and additional funding above the conventional official development assistance finance already provided to the developing countries. However, a recent report indicated that the UNFCCC

will consider any finance as L&D financing, including the finance already provided (UNFCCC 2019c). Regardless, Ciplet, Roberts & Khan (2013) have raised concerns that the developed countries are recycling their official development assistance finance towards climate finance and renaming past pledges as commitments to Fast Start Finance. This significantly undermines credibility and trust in the political process.

The global finance architecture is complex with many actors, funds, and instruments (Richards & Schalatek 2017). A closer look at the global finance architecture indicates that it constantly evolves with considerable overlap between official development assistance, DRR, humanitarian aid, and adaptation finance. Climate funds flow within and outside the UNFCCC, mainly through multilateral, bilateral, and national climate change funds (Nakhooda, Watson & Schalatek 2013). The financial mechanism of the UNFCCC and its operating entities include the Global Environment Facility (GEF), the Green Climate Fund (GCF), and the Adaptation Fund (AF) (Gomez-Echeverri 2013). While there are already a considerable number of financial instruments available, it would be worthwhile to consider the challenges, operationalisation, and the suitability of these instruments for a potential financial mechanism for L&D. Since the UNFCCC invites the Board of the GCF to provide financial resources for L&D, along with adaptation and mitigation finance (UNFCCC 2019b), the section below provides an overview of GCF.

2.6.3.1 Green Climate Fund

The GCF is a multilateral financing entity established in 2010 as part of COP 16 to address climate mitigation and climate adaptation (UNFCCC 2011). The GCF is guided by the principles of the UNFCCC and functions under the guidance of COP. The GCF is mandated to make a "significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change" (GCF 2011; Richards & Schalatek 2017, p. 26). The GCF seeks to promote low emission and climate-resilient development by taking into account the needs of vulnerable communities (GCF 2019a).

Currently, as the largest multilateral climate fund, the GCF funds medium to large-scale adaptation projects and programmes valued at over US$250 million. The GCF also has accredited national institutions with direct access to funds (Pekkarinen, Toussaint & van Asselt 2019). Although the governing instrument of the GCF does not make any reference to L&D due to the political nature of L&D, the funding structure has "the authority to add, modify and remove additional windows and substructures or facilities as appropriate" which is an indication that L&D financial trust window could be part of the GCF (GCF 2011). Regardless, it is unclear how L&D finance will be mobilised under the GCF.

The sources of funds in the GCF originate from public and private, bilateral and multilateral, and alternative sources (UNFCCC 2011). The GCF has committed 50 percent of its funding to adaptation and 50 percent to mitigation. Under the allocated adaptation finance, 50 percent of these funds go to the most vulnerable countries (GCF 2019b). According to Roberts & Weikmans (2017), countries to be prioritised for adaptation funding are LDCs, SIDs, and African countries. However, there is ambiguity on how to prioritise between these countries and which countries qualify as a vulnerable country in need of climate finance. Huq (2016) further criticised the GCF by stating that the "micro-scrutiny" of paperwork used by the GCF is inefficient, resulting in huge paperwork and little flow of money to vulnerable countries.

More importantly, placing L&D finance under the GCF would create challenges in fund allocation and affect current mitigation and adaptation financing.

While the GCF is expected to play a key role in the governance of long-term finance, the key issue of how to govern the US$100 billion per year pledge remains unsolved (Fridahl & Linnér 2016). Cui & Huang (2018) argued that financing of GCF is challenged by insufficient funds due to unclear rules or trajectories to raise and distribute funds. While scholars have argued that GCF has an administrative role to play in L&D finance (Pill 2022), many scholars have also argued that a new L&D finance facility should be developed based on polluter pay principle, international cooperation, and historical responsibility (Sharma-Khushal et al. 2022).

2.7 Setting the scene: Climate change and variability in Fiji Islands

The Republic of Fiji Islands is an island nation of the Melanesian group in the South Pacific, between longitudes 175° East and 178° West and latitudes 15° and 22° South (GEF 2012). The Fiji Islands consists of 330 islands of which 110 islands are inhabited (World Bank Group 2019). It has an oceanic tropical climate (Agrawala et al. 2003) and has relatively constant temperature throughout the year, with an average of 23-25 ℃ in the dry season (May-October) and 25-26 ℃ in the wet season. On average, temperatures between the colder months (July-August) and warmer months (January-February) vary only between 3-4 ℃. The inter-annual fluctuations in temperature are also typically low (Government of Fiji 2013) and are strongly tied to the surrounding ocean temperatures (Waqaicelua et al. 2011).

Rainfall distribution is primarily affected by terrain - leeward sides of the islands tend to be drier while the windward sides are wetter (Agrawala et al. 2003; Fiji Meteorological Service 2006). A larger seasonal variation is noted in precipitation during the wet and dry seasons. The wet season has an average rainfall of 250-400 mm per month while the dry season has 80-150 mm of rainfall per month. The annual precipitation also indicates a spatial variation on the larger islands, with more precipitation recorded on the east as compared to the west (World Bank Group 2019).

The position of the South Pacific Convergence Zone (SPCZ) greatly influences the amount of rainfall (Kumar, Stephens & Weir 2013). During the dry season, the SPCZ is positioned to the northeast of Fiji while in the wet season the SPCZ is positioned over Fiji (Government of Fiji 2013). Fiji's climate is also influenced by trade-winds blowing from the east or southeast direction associated with the Hadley circulation. The trade-winds are responsible for bringing in moisture onshore which causes heavy rainfall in the interior and eastern parts of the larger islands (Kuleshov et al. 2014).

The El Niño events which position the SPCZ zone in the northeast are a cause of major drought in Fiji (GEF 2012; World Bank Group 2019). During the El Niño Southern Oscillation (ENSO), drier and hotter than normal conditions are expected from December to February and cooler and drier conditions are expected from June to August (Agrawala et al. 2003). During an ENSO event, lower than normal rainfall can be expected over most of Fiji. However, the severely affected areas tend to be the west of the main islands (GEF 2012).

The Fiji Islands are also well-known for frequent tropical cyclones with damaging winds, storm surges, floods, and rain (PCRAFI 2011). The cyclones track from the north and the west and normally occur during the wet season from November to April but occasionally

occur in October and May during El Niño years (GEF 2012; Waqaicelua et al. 2011). From 1969-2010, the centre of 70 tropical cyclones have passed within 400km of Suva, the capital of Fiji (Waqaicelua et al. 2011). There is moderate confidence that tropical cyclones are projected to decline over the 21st century (Waqaicelua et al. 2011). While there will be less frequent cyclones, the average maximum wind speed of cyclones are projected to increase by 2-11 percent and an increase in rainfall intensity by 20 percent within 100 km of the cyclone centre (CSIRO 2011).

Furthermore, according to climate projections, the surface air and sea-surface temperatures are projected to continue to rise in the 21 century (Waqaicelua et al. 2011). National warming trends have been noted in annual average maximum and minimum temperatures since the 1950s in line with the global warming trend (Kuleshov et al. 2014). Most notable change in climate will occur in 2030 with an increase in annual mean temperature of 0.7 ℃ (Government of Fiji 2013). By 2090, under high emission scenarios, the projected temperature increase is projected to be greater than 2.5 ℃ in Fiji (Waqaicelua et al. 2011). An increase in average temperature will also result in higher numbers of hot days and warm nights and a decline in cooler conditions (CSIRO 2011). Sea-level is also projected to rise over the 21st century. Sea-level around Fiji has been rising by 5.5 mm per year since 1992 (Martin et al. 2018), and climate models project a rise of 5-15 cm by 2030 and an increase of 20-60 cm by 2090 (Waqaicelua et al. 2011).

Likewise, the current level of risk posed by droughts are significant for Fiji and will continue to be so in the future. Although little change is projected for drought (Waqaicelua et al. 2011), there is evidence to suggest that Fiji will be subject to increased climate variability between El Niño and La Nina like conditions (Agrawala et al. 2003; Nunn 2009). It is also possible that droughts may become more frequent (Becken 2005). The projection for rainfall is quite ambiguous and different models project different levels of precipitation creating uncertainty about future rainfall patterns and drought risks (The World Bank 2018). One study suggested a negligible change in mean annual rainfall is represented by 69 percent of the climate models (Government of Fiji 2013). Evidence suggests that heavy rainfall events will become more intense but less frequent (Barnett 2011; Lal 2004) while total rainfall may decrease (Becken 2005; Kumar, Deo & Ramachandran 2006). These changes in precipitation level will have implications for soil moisture and water availability for agricultural production and domestic use (Becken 2005).

Fiji is exposed to a large number of environmental risks. Climate change, being a threat multiplier, will amplify these risks (The World Bank 2018). The vulnerability of Fiji's communities is shaped by the interaction of bio-physical and socio-economic factors (Thomas et al. 2018), such as changes in weather patterns (Currenti et al. 2019), including earlier onset of rainfall, warmer temperatures, more intense cyclones, frequent droughts, severe flooding, increasing salinity which affects soil conditions, and sea-level rise. In particular, slow-onset events combined with sudden events make these small islands more vulnerable and compound the associated current and future risks (Gero, Méheux & Dominey-Howes 2011; McNamara & Jacot Des Combes 2015; Wewerinke-Singh & Salili 2019). Seasonal shifts and prolonged droughts have also been identified affecting livelihoods with adverse implications for agriculture, food security, and human health (Pearce et al. 2018). This will have a drastic impact on all sectors including the agricultural sector and will have severe economic implications for Fiji (GEF 2012). Viti Levu, the largest island of Fiji, has been projected to

incur climate-related disaster costs equivalent to 2-4 percent of Fiji's gross domestic product by 2050 (Falco & Sharma-Khushal 2019).

2.8 Fijian agriculture

Fiji's agriculture is diverse and consists of crops, livestock, fisheries, and forests (Republic of Fiji 2017). Fiji's agriculture depends on rainfall rather than a formal irrigation systems (Barnett 2011). Fijian agriculture is considered a central component of Fiji's economy. The agricultural sector provides food and raw materials for the domestic market, generates employment and income through export, and supports the manufacturing and tourism industry (Berno 2011; Gani & Scrimgeour 2019; Hone, Haszler & Natasiwai 2008). From 2001-2011 the agriculture sector had a significant contribution equivalent to 10.6 percent of the country's gross domestic product (GDP) and employed closely two-thirds of the labour force (Bacolod 2014; Hone, Haszler & Natasiwai 2008). In 2014, the agricultural sector contributed 9.4 percent of the GDP (Esler 2016). Fiji's agriculture is a blend of commercial and subsistence farming, although commercial farming predominates (Fiji Government 2019a).

Subsistence farming and sugarcane dominate Fiji's agriculture (FAO 2012a). Most households in Fiji cultivate crops for subsistence and cash alongside a steady employment. In the wet region, the dominant crops are coconut, ginger, cassava, taro, kava, banana, and breadfruit (Fiji Government 2019a). The region with intermediate rainfall cultivates mostly vegetables, cocoa, and passion fruit (Fiji Government 2019a). Previously, the agricultural sector was regarded as the backbone of Fiji with sugarcane as the main crop (Fiji Government 2019a).

2.8.1 History and background of Fiji's sugar industry

Fiji's sugar industry has a rich history dating back to the late 1800's (Singh 2020). Sugarcane first became an important commodity in Fiji in the 1870's and over the following decades thirty four small sugar mills were established (Ali & Narayan 1987). The Colonial Sugar Refining Company (CSR), a company that was successfully operating sugar mills in Queensland and New South Wales, became interested in Fiji in 1880 upon the invitation of the Fijian government (Ali & Narayan 1987). During the early years, all developments in sugar occurred in the wet areas near Suva as it was believed that wet regions would give a higher yield. Although sugarcane yield was noticeably high, the sugar content was very poor (Ali & Narayan 1987).

In the mid-1870's, the sugar industry started to face labour shortages. The Governor of the colony, Sir Gordon, was determined not to interfere with the lifestyle of indigenous Fijians or their land. Hence, it was decided that Indians would be brought over under the indentured labour system (Singh 2020). Indians first arrived in 1879. The arrival of Indian labourers stopped in 1916 and the indentured system was discontinued in 1920 (Ali & Narayan 1987). Since then, Indo-Fijians have lived in Fiji for more than three generations and are descendants of more than 60,000 *girmitiyas* or indentured labourers who were brought over from India by the British Colonial government to work on Fiji's sugar plantations (Trnka 2005).

Once the indentured system was abolished, the industry was again faced with shortage of labour. It was then decided by the CSR to introduce a system of contract growing of sugarcane by small tenants (Ali & Narayan 1987). An average land size of 4.05 hectares was allocated to tenants for smallholder sugarcane farming (Serrano 2007). Therefore, sugarcane

farming in Fiji is family-based and not what one would find in a business enterprise (Reddy 2003). Shortly after Fiji gained independence in 1970, the CSR withdrew operations in 1973 and the operations of the sugar industry was handed over to Fiji Sugar Corporation Limited (FSC) and the Fijian government is the major shareholder in the milling company (Ali & Narayan 1987; Snell & Prasad 2001).

2.8.2 Sugar industry stakeholders

The structure of the sugar industry is complex and is made up of many stakeholders. The two main stakeholders include the sugarcane growers and the FSC. FSC is the only miller in Fiji and owns and operates three mills and railway systems (Reddy 2003). Other stakeholders in the sugar industry include the Fijian government (Ministry of Sugar Industry), Sugar Industry Tribunal, Sugarcane Growers Council, Sugarcane Growers Fund, the Sugar Research Institute of Fiji (SRIF), and the *iTaukei* Land Trust Board. Provided below are brief roles of its stakeholder under a diverse governance system:

- **Fiji government**: the government plays a dual role in the sugar industry. It is the majority shareholder in the milling company and also has to implement laws governing the industry (Reddy 2003).
- **The Ministry of Sugar Industry**: the Ministry of Sugar Industry was established to develop policies, implement reforms, and provide an enabling environment for efficient services to all its stakeholders and sugarcane communities. The Ministry of Sugar Industry also provides subsidies and grant assistance to farmers. It further promotes adoption of modern technology and encourages sustainable land management (Ministry of Sugar Industry 2021a).
- **The Sugar Industry Tribunal**: the Sugar Industry Tribunal was established with the aim to deal with contractual relations between FSC and farmers and any disputes within the industry (FSC 2021).
- **The Sugarcane Growers Council**: the Sugarcane Growers Council was established to represent farmers' interests (FSC 2021).
- **The Sugarcane Growers Fund**: the role of the Sugarcane Growers Fund is to provide loans to registered sugarcane growers and stakeholders of the sugar industry (SCGC 2021).
- **SRIF**: SRIF was established in 2006 to assist in research development and extension services. It is also responsible for disseminating technology and information for increased productivity, profitability, and sustainability of Fiji's sugar industry (SRIF 2021a).
- **The *iTaukei* Land Trust Board**: the *iTaukei* Land Trust Board handles the leasing and rent arrangement for Fijian-owned land on which sugarcane is grown. The Board deals with the relationship between the landowners and farmers (FSC 2004).
- **Farmers, sugarcane cutters, and other employees (example, sugarcane truck drivers)**: Indo-Fijian and Indigenous Fijians supplying sugarcane to the mills.

2.8.3 Fiji's sugar industry

Sugarcane farms in Fiji are concentrated on the two larger islands – the Western side of Viti Levu and the north of Vanua Levu (Chandra et al. 2018). Sugarcane is an economically important crop as 22 percent of Fiji's population are directly or indirectly dependent on the sugar industry in the Western and Northern Divisions (Chandra et al. 2018). Sugarcane farming is primarily undertaken by Indo-Fijians with some 22,500 farms (Akram-Lodhi

1997). At farm level, demographically, the Indo-Fijians make up 75 percent of the total sugar industry (Mahadevan 2007). Small farms are a characteristic feature of the sugar industry. Each cane grower, on average, has 7 hectares of land, of which 4.2 hectares is used for sugarcane production (Prasad & Kumar 2016) and the rest is used for horticulture or vegetable farming (referred to as cash crops in Fiji), and for subsistence purposes (Lal, Lim-Applegate & Reddy 2001).

However, in terms of production efficiency, Fiji's sugarcane yield is well below major producers such as Australia and even other African, Caribbean, and Pacific producers. Fiji has second lowest sugarcane yield and lowest sugarcane yield harvested per hectare (Mahadevan 2008). In the early 1990's, agriculture contributed about one-fifth of Fiji's GDP (Akram-Lodhi 1997) with sugar as the main export crop accounting to 40 percent of the total export (Booth 1999). From 2005-2016, sugar export earnings have fallen by 31 percent while sugarcane production has declined by 43 percent (Sami 2020). In 2019, the sugar industry contributed 1.1 percent of the total GDP and generated about 4.5 percent of the total export (FSC 2020).

The sugar industry has been the mainstay of Fiji's economy for many decades. Despite the significance of the sugar industry, in recent years, Fiji's sugar industry has faced many challenges such as social conflict and political instability (Bacolod 2014; Lal & Prete 2008; Duncan & Sing 2009; Pelling & Uitto 2001), land tenure insecurity (Lal, Lim-Applegate & Reddy 2001; Moynagh 1978; Prasad & Kumar 2016), weak policy and coordination (FAO 2012a), inadequate extension services, undeveloped local and export markets, lack of infrastructure and insufficient technologies (Booth 1999; Kurer 2001a), and severe impacts from cyclones and drought (Bacolod 2014; Esler 2016; Government of Fiji 2012; Pearce et al. 2018; Zhao & Li 2015). Despite these challenges, many farmers are continuing with sugarcane farming as this occupation was passed down to them from past generations (Singh 2020). Therefore, the sugar industry remains the primary livelihood source for many rural households.

2.9 Localising climate change loss and damage in Fiji's sugar industry

Recent cyclones in Fiji, such as tropical cyclone (TC) Evan, TC Winston, and TC Yasa, with accompanying destructive winds and flash floods caused massive L&D to the agricultural sector, including the sugar industry (Government of Fiji 2012; UNOCHA 2003; Esler 2016). In December 2012, TC Evan caused significant damage to crops and mill infrastructure. The cost of repairs to FSC's infrastructure amounted to FJ$1.2 million (FSC 2013). On 20th February 2016, TC Winston, a category five cyclone and one of the strongest recorded in the Southern Hemisphere, made landfall in Fiji (Ram, Brook & Cronin 2018).

During TC Winston, Fiji's communities experienced loss of homes, loss of property, loss of lives, damage to critical infrastructure such as hospitals and schools, and damage to ecosystems (Chaston et al. 2016; Thomas et al. 2018). Many critical ecosystems will take at least 15 years to recover and deliver the same quality of ecosystem services prior to the cyclone (Esler 2016). In many places, entire communities were wiped out (Nakamura & Kanemasu 2020) leaving many people traumatised by the cyclone experience (Esler 2016). Many months after TC Winston, families struggled to provide basic needs such as food and water for their children (Rowan Gard & Veitayaki 2017).

At the sectoral level, Fiji's sugar industry sustained severe L&D. For instance, sugarcane production declined as TC Winston struck during the planting season (Esler 2016). As a result, the sugar industry recorded the lowest sugarcane production in the entire history of the sugar industry (FSC 2016). Additionally, substantial damages were mainly sustained to farm sheds and stores, drainage systems, roads, and mills (Esler 2016). One of the biggest and ongoing damages encountered during TC Winston by the sugar industry was the forced closure of the Penang sugar mill. According to the 2016 annual report compiled by FSC, due to Penang mill's extensive damage and non-viability of the facility, the FSC Board decided to permanently cease all operations of the Penang sugar mill (FSC 2016). Notably, property, plant, and equipment of FSC were not insured for various risks such as fire, floods, and cyclones as the cost of insurance cover was very high (FSC 2012). Consequently, due to the impact of cyclone and flooding, FSC had to borrow money from the Reserve Bank of Fiji (FSC 2016) to repair its infrastructure.

The Post Disaster Needs Assessment (PDNA) from TC Winston indicated that the estimated value of damage to the sugar industry was FJ$21.8 million while the estimated value of loss was FJ$53.6 million. Fiji received assistance from the international community in the form of humanitarian funding, longer-term public financing, and loans. Regardless, almost 85 percent of the cost of the disaster was borne by the people of Fiji (Richards 2018) and the majority of the L&D from TC Winston remained unfunded, including compensation for livestock, loss of homes, and ecosystem degradation. Following this devastation, six weeks later, TC Zena passed over Fiji causing more rainfall and flooding and also impacting the agricultural sector (Esler 2016).

Drought is also a growing concern for the agricultural sector in Fiji. Most of the meteorological drought in Fiji is associated with strong El Niño events which result in severe rainfall reductions (Koroiwaqa 2016; Mataki, Koshy & Lal 2006; Kumar, Deo & Ramachandran 2006). A decline in rainfall presents a significant challenge to Fiji as the country largely lacks modern irrigation systems (Nawai et al. 2015b). The 1997/98 El Niño drought in Fiji was described as a 1-in-100 year event and led to a severe water crisis, reducing agricultural production, increasing mortality of livestock, causing numerous health problems, wildfires, loss of soil fertility, and saline water intrusions (Kelman 2019; Pearce et al. 2018; Rhee & Yang 2018; Terry 2005). During the severe drought of 1997/98, rainfall failure occurred across two consecutive dry seasons (Rhee & Yang 2018). As a result, sugarcane harvest was reduced by 50 percent (Wairiu 2017), and in some areas, sugarcane crops were completely destroyed (Feresi et al. 2000; Lightfoot 1999). Consequently, sugar exports declined by nearly 30 percent (Zhongwei 2015). More than one-third of Fiji's population needed emergency food and water supplies (Terry & Raj 2014). Shortage of food and water also caused nutritional deficiencies and other health problems (Lightfoot 1999). This widespread drought and famine cost the agricultural sector an estimated US$65 million (Barnett 2001; Feresi et al. 2000) and in total, Fiji's economic loss was estimated to be FJ$275-300 million (Richards 2018).

Yet, the estimated loss did not include NELD such as health-related costs for dengue fever, heat stroke, cardiovascular disease, and respiratory disease (Richards 2018). Government assistance and external aid were heavily relied on for recovery purposes. Still, they did not meet the needs of vulnerable communities (Feresi et al. 2000). In 2015, a well below the

target of 1.86 million tonnes was recorded due to the drought experienced in the 2014/2015 sugarcane planting season (FSC 2015).

Undoubtedly, impacts from sudden and slow-onset events and resulting L&D presents an existential threat for the sustainability of the Fijian sugar industry. Unjust harm from climate change impacts also raises a concern for climate justice and mobilisation of much-needed resources by developed countries to avert, minimise, and address L&D. While international support is necessary to address L&D and has been slow to arrive, the Fijian government needs to show leadership to address L&D and devise innovative solutions.

Various studies have been conducted in Indo-Fijian sugarcane farming communities to examine climatic risks and the sustainability of Fiji's sugar industry. Anshuka et al. (2021a) examined vulnerability to hydro-meteorological risks (cyclones and floods) at micro and macro household level. The study revealed that at the micro-level climatic, physical, and socio-economic, and cultural factors contribute to household vulnerability. At the macro-level, informal living arrangements and access to land tenure enhance vulnerability to climatic risks. Research in Fiji's sugar industry by Kumari & Nakano (2016) and Prasad & Tisdell (2006) emphasised that weak tenure arrangements under formal leasing system have reduced farm investments and significantly decreased sugarcane production.

Recent research by Nakamura & Kanemasu (2020) emphasised that although social capital does play a role in community resilience, Indo-Fijians are not necessarily bound by communal values. Indo-Fijians are more self-reliant and show individualism when dealing with disasters, disaster relief, response, and recovery. Neighbourly assistance is provided to members of the community upon request, particularly elderly members of the community. Consequently, the lack of social capital results in isolated disaster preparedness, response, and recovery with heavy reliance on immediate family members for support. As government relief mechanisms are limited and slow to arrive, residents are left on their own to recover, rendering them more vulnerable.

In another study, Dean (2022a) examined local challenges associated with sugarcane farming and sugar production in Fiji. The study revealed a steady decline in sugarcane production due to limited market development, ecological, environmental, geopolitical, socio-economic factors, and farmer's weak position in the sugar industry. Exacerbating these challenges is the expiry of preferential agreement with the European Union (Sami 2020) and the detrimental impacts of COVID-19 pandemic disruptions on Fiji's sugar industry, including planting, loss of jobs, and mill and field operations adversely affected by COVID-19 lockdowns as well as global border restrictions, trade barriers, and narrow distribution channels (Sachan & Krishna 2021; The Fijian Government 2020).

Given the adverse impact of climatic and non-climatic factors on the sugar industry, Singh (2020) recommended important policy intervention such as crop diversification. Crop diversification provides significantly provides higher farm profitability than compared to sugarcane farming alone. Other policy interventions aimed at reducing SES vulnerability and enhancing adaptive strategy include access to information, education, improvement in forecasting and early warning systems, and long-term land lease (Anshuka et al. 2021a; Dean 2022b).

While various studies have been conducted in Indo-Fijian sugarcane farming communities, it is important to note that to date, no study has explicitly examined the interlinkages between SES vulnerability, climate adaptation, L&D, and institutional and policy capacity in Fiji's sugar industry to avert, minimise, and address L&D. To fill this research gap, this study examines SES vulnerability, implementation of adaptation measures for cyclones and droughts, resulting L&D, including NELD and cascading impacts, and institutional and policy measures to avert, minimise, and address L&D in Fiji's sugar industry.

2.10 Averting, minimising, and addressing climate change impacts and loss and damage in Fiji's agriculture

Climate change and climate variability will enhance all climate-related hazards in Fiji (UNDRR 2019). According to UNFCCC (2019a) avert and minimise strategies are pre-emptive strategies such as DRR and climate adaptation measures used to prevent L&D while address categories are poorly defined. According to Pill (2022) addressing L&D includes identification of L&D funding mechanisms. While L&D finance facility is still a contentious issue at the international level, addressing climate change L&D in Fiji's sugar industry has been achieved through mobilising finance through the national budget and other innovative finance. The section below briefly discusses each of these responses.

2.10.1 Agricultural adaptation

While some climate change impacts are unavoidable, the ability to lessen or avert some impacts depend on disaster preparedness and adaptation measures (Nunn et al. 2014). Under changing climate, farmers have adopted various climate adaptation measures. For example, in the village of Nawairuku, Fiji, Currenti et al. (2019) identified successful agricultural adaptation measures. These measures included intercropping, crop diversification, crop rotation, and implementing drainage system. Diverse traditional crops, agroforestry, and integrated farming practices have also seen to increase resilience of the agricultural system (Pacific Community 2012). The villagers of Nawairuku have also relocated many agricultural fields away from flood-prone areas to higher steeper ground. While this strategy has reduced exposure to floods, this has led to maladaptive practices which have caused landslides (Currenti et al. 2019).

Research in Fiji has highlighted the significant role of traditional knowledge in cyclone and drought preparedness and implementation of adaptation responses (McNamara & Prasad 2014). This is partly because traditional knowledge has accumulated over many generations and is instrumental for understanding local level changes, responding to social and ecological changes, and enhancing adaptive capacity of communities (Nakamura & Kanemasu 2020; Veitayaki 2010). Through the use of traditional knowledge, many villagers become aware of an approaching cyclone due to extremely hot weather, sea birds flying inland, and unusual abundance of fruits (three or four fruits in one branch) (Government of Fiji 2012). Therefore, traditional knowledge can assist in informing decision-making and implementation of adaptation measures at the local level (Carrico, Truelove & Williams 2019).

Prior to a cyclone event, the local communities are seen to prepare for the cyclone by undertaking personal and property protection actions (McNamara & Prasad 2014). This includes securing their properties, placing shutters on windows, ensuring that the main electricity is switched off, and finding a safe shelter (Magee et al. 2016). Households also prepare for cyclones by purchasing battery operated torch and radio and a first-aid kit

(McNamara & Prasad 2014). Gardens and areas of vegetations are cleared so that these do not cause damage. Cyclone-resilient crops are saved so that they can be consumed or sold later (Magee et al. 2016). Recently, traditional methods such as cutting stems of ready-to-harvest cassava plants, burying the harvest of taro, and preserving breadfruits and smoked sea-food are being integrated for disaster preparedness and response (Fletcher et al. 2013). People also gather non-perishable food items such as biscuits, flour, sugar, and canned food. Social media is increasingly used to stay updated and to share experiences (Finau et al. 2018). In most cases, people become aware of the cyclone through radio broadcasting updates, text messages, and updates from the meteorological services. Television broadcasts with the use of sign language have also been issued in the hope of targeting vulnerable groups.

Similarly, before the onset of a dry season, villagers are encouraged to plant drought-tolerant crops such as sweet potato, cassava and yams. In Vusama village, Fiji, during prolonged periods of prolonged drought, the village takes adaptation measures such as digging wells deeper than normal, rationing the borehole water, changes in diet, planting fruits and vegetables in other locations, and receiving food from family members (Pearce et al. 2018). Similar drought adaptation measures have been noted by McNamara & Prasad (2014) in rural Fijian villages. During periods of water shortages, communities use alternative water sources such as rainwater for cooking and drinking, boreholes, wells, and springs (McNamara & Prasad 2014). Many farmers also diversify their livelihoods in response to drought (Pearce et al. 2018; Morton 2007). In worst-case scenarios, people adapt to drought by selling assets to buy food or reduce their food consumption (Roberts et al. 2014; Yaffa 2013). Currently, there is no modern irrigation or drip irrigation in sugarcane fields to prepare for drought in Fiji (Reddy & Yanagida 1998). As a result, there is a need to focus on long-term innovative solutions to improve on water crisis and water infrastructure, drought preparedness, and response in Fiji (Fiji Government 2019b).

The Ministry of Sugar Industry is also implementing cyclone and drought adaptation measures under changing climatic conditions. These adaptation measures include breeding new climate-resilient sugarcane varieties (SRIF 2021b), provision of climate and weather outlook (Fiji Meteorological Services 2021), livelihood diversification (Singh 2020), technology transfer and providing technical support to farmers (SRIF 2021c), and promoting sustainable farm management practises (SRIF 2021d).

Despite implementing adaptation measures, current research indicates that Fijian communities are still vulnerable to climate change impacts (Chandra & Gaganis 2016; Shabina et al. 2021). As a result, local communities are facing irreversible losses and intolerable risks (as discussed in Section 2.9) – an indication that current adaptation measures are inadequate to prevent L&D. While various climate change studies have been conducted in Fijian villages (Charan, Kaur & Singh 2018; Miyaji et al. 2021; McNamara & Prasad 2014; Nakamura & Kanemasu 2020) to date, there has been no climate change study conducted in Indo-Fijian sugarcane communities and more broadly in Fiji's sugar industry. To fill this research gap, this study will examine adaptation measures implemented by Indo-Fijian farmers to prevent L&D from cyclones and droughts. This research will also identify adaptation constraints marginalising rural and remote communities increasing their vulnerability to cyclones and droughts and resulting in L&D.

2.10.2 Recovery and reconstruction needs

Recovery and reconstruction efforts after any disaster are crucial for building a better tomorrow (Miyaji et al. 2021; Rowan Gard & Veitayaki 2017). Recovery includes restoration, enhancement, and the opportunity to build back better when repairing and reconstructing infrastructure to increase resilience (Ministry of Economy 2016a). Recovery measures are short-term activities designed to mitigate and shorten the adverse impacts of disaster on an economy. In the agricultural sector, recovery efforts must be undertaken quickly as many people depend on this sector for food and employment (FAO 2012b).

After TC Winston in Fiji, one of the biggest challenges faced during the emergency response was the lack of liquidity (Noy & Edmonds 2016). The Fijian government together with the United Nations launched a flash appeal as emergency funding and managed to raise US$19.8 million (Richards & Schalatek 2017). Recovery needs of TC Winston focused on providing emergency inputs to farmers, inclusion and identification of vulnerable groups, nutrition and food security concerns, and strengthening resilience to future shocks. Seeds, cuttings and other agricultural inputs were also handed out (Esler 2016). Additionally, the Fijian government along with development partners were able to mobilise the national humanitarian clusters to coordinate recovery and reconstruction efforts (Esler 2016). Other recovery programmes included a range of social protection programmes such as the Poverty Benefit Scheme, Food Voucher Programme, and Help for Homes Initiative to support households and provide relief (Esler 2016). The Fiji National Provident Fund (superannuation fund) also allowed affected members to withdraw up to FJ$5000.00 for immediate housing assistance (Ministry of Economy 2016a).

Reconstruction measures are intended to sustain recovery efforts and mitigate future disasters (Esler 2016). Some examples of reconstruction include replacement of agricultural machinery, relocating vital facilities to safer areas, and constructing new agricultural amenities such as storage buildings using a building back better strategy (FAO 2012b). After a disaster, reconstruction needs focused on medium to long-term infrastructural support and building technical capacity to build back better (Esler 2016). For the sugar subsector, recovery and reconstruction focused on sugarcane production through producing seedlings and planting new sugarcane, provision of farmer support services, and capacity building for the sugar industry (Esler 2016). Fiji’s government also assisted with immediate reconstruction of damaged houses through the National Disaster Relief and Rehabilitation Fund (Government of Fiji 2012). However, given the severity of L&D caused by the recent cyclones, reliance on local funding to deal with costs associated with disasters has the potential to overrun small national budgets and hinder opportunities for sustainable development across the PICs (Sharma 2017).

During the 1997/1998 drought, recovery needs included provision of supplementary food rations and water supply. The food ration was provided to more than 28,000 households and water to 48,000 households. By October 1998, more than 54,000 families were receiving food supplies and more than half of Fiji's population received water deliveries. The assistance was further extended to the island provinces in the Eastern Division. Many families relied on food rations for nearly twelve months after the drought (Lightfoot 1999).

Given that recovery and reconstruction efforts are necessary to identify needs of the communities to build back better and a resilient future, this thesis will examine how

efficiently resources were mobilised for cyclone and drought recovering and reconstruction purposes in Fiji's sugar industry. In addition, this research will examine the crucial role of L&D governance and key stakeholders in averting, minimising, and addressing L&D in Fiji's sugar industry.

2.10.3 Climate change and disaster risk financing options in Fiji

Finance for DRR, climate adaptation, and L&D are crucial for building a resilient economy. The Fiji Development Bank is Fiji's national direct access entity to the GCF (Government of the Republic of Fiji 2022). In the past, the Fiji Development Bank was able to access US$5 million in project funding to develop an innovative solar agro-photovoltaic and a battery storage system on the island of Ovalau (FDB 2020). To access GCF, Fiji has put forward detailed climate-related projects across 12 sectors to mitigate climatic impacts. These projects are aligned with domestic and international climate change priorities (Government of the Republic of Fiji 2022).

At the sector level, Fiji's Ministry of Sugar Industry has been allocated a total of FJ$53.6 million in the national 2020-2021 budget (The Government of Fiji 2020). The Ministry of Sugar Industry will implement seven capital programs valued at FJ$50.9 million from this national budget. These programs are targeted to enhance sugarcane production and include Cane Access Roads, Sugarcane Development and Farmers Assistance, Sugar Stabilisation Fund, New Farmers Assistance Scheme, Fertiliser Subsidy, Weedicide Subsidy, and Cane Cartage (Ministry of Communication 2021). While these programs are aimed to enhance sugarcane production, none of these programs are linked to specifically addressing the impacts of climate change or disasters.

Under the Ministry of Rural and Maritime Development and Disaster Management, FJ$800,000 has been allocated for a Disaster Relief and Rehabilitation Fund (The Government of Fiji 2020). The Disaster Relief and Rehabilitation Fund is used to respond to any national-scale adverse events, including climate-induced, biological, and technical disasters. Given that Fiji is constantly battling with severe cyclones, floods, drought, and sea-level rise, the Disaster Relief and Rehabilitation Fund is insufficient for recovery and rehabilitation purposes. Hence, external aid has been heavily relied on for recovery purposes (Feresi et al. 2000). This was clearly evident during TC Winston. For disasters such as TC Winston, estimated losses and damages amounted to FJ$1.99 billion (Esler 2016), indicating the severity of L&D and the governments' inadequacy to respond effectively.

Fiji has also introduced innovative finance for climate-resilient development. The government of Fiji is working to develop innovative finance and insurance products that are tailor-made and affordable for vulnerable and low-income households in Fiji. One example of innovative finance is the Drua Incubator with support from Luxembourg and the Asian Development Bank. The Drua initiative will be used to increase the flow of climate finance, particularly from the private sector into projects that help Pacific communities adapt to climate change (COP 23 2017).

Likewise, Fiji is one of the first developing countries to issue a sovereign Green Bond to raise more than US$50 million to support CCA and mitigation projects (Government of Fiji 2018; IFC 2017). The Green Bond is a loan provided to the government of Fiji by an investor with a guarantee of set interest repayment of full amount. It is a source of fixed income and liquid

financial instruments that are used to raise funds dedicated to climate resilience and green environmental projects. The first tranche of the Green Bond drew unprecedented support from investors and was oversubscribed raising double the capital of US$40 million (Government of Fiji 2017). Fiji will also use the proceeds from the Bonds to support its commitment to achieve 100 percent energy and reduce emissions by 30 percent in the energy sector by 2030 (The World Bank 2019). The Green Bond will help support Fiji's commitment to the Paris Agreement and finance projects such as crop resilience, flood management in sugar cane fields, reforestation, and build back better infrastructure (IFC 2017).

Another initiative by the government of Fiji is the Environment and Climate Adaptation Levy (ECAL). The ECAL is a consortium of taxes on prescribed services, items, and income. The proceeds from ECAL are used to finance projects across Fiji to protect the natural environment, build resilient infrastructure, enhance disaster relief and response, improve agricultural development, and reduce the carbon footprint of Fiji. Since the introduction of ECAL in the 2017/2018 financial year, it has raised FJ$270.2 million of which FJ$255.9 million has been used to finance 102 projects. At the end of third quarter of the 2018/2019 financial year, the ECAL proceeds collected were a total of FJ$119.7 million. The majority of the ECAL proceeds are allocated to CCA and disaster risk projects. The Fijian government also plans to transfer a percentage of ECAL proceeds into the Climate Change Relocation Trust Fund to help raise bilateral and multilateral funds to help relocate low-lying and vulnerable communities (Government of Fiji 2019).

Furthermore, the government of Fiji is partnering with The World Bank to make affordable property insurance accessible for low-income households in Fiji. Parametric insurance for agricultural sector is also being considered (Republic of Fiji 2017). Recently, FijiCare Insurance Limited in partnership with United Nations Pacific Financial Inclusion Programme (PFIP) and the Sugarcane Growers Fund provided new micro-insurance to low-income households for buildings, funeral, and personal accidents at a low and affordable price (FijiSun 2019). Even though the new micro-insurance is available to sugarcane farmers for building resilient households and daily protection against accidents, it does not protect farmers against climate events which is very much-needed in the agricultural communities of Fiji.

Clearly, addressing L&D in Fiji would require access to climate finance and innovative funds. While the Fijian government has put forward detailed projects to be financed under the GCF and is introducing innovative finance to mitigate climatic risks, this thesis will examine the ability of the Ministry of Sugar Industry to access GCF and domestic funds to address L&D.

2.11 Conclusion

This chapter has provided a brief history of L&D negotiations highlighting the political nature of L&D debate at the international level. The chapter then emphasises the relevance of climate justice theory and SES theory arguing for climate justice and the need for adaptive governance and transformational adaptation. This chapter emphasises that despite implementing adaptation measures, vulnerable countries including Fiji, are experiencing irreversible losses and intolerable risks. L&D also makes a stronger case for climate justice as vulnerable communities are disproportionally affected by climatic impacts and L&D and have the least capacity to respond to climate risks. Currently, the Fijian local adaptation measures, disaster response and reconstruction, and access to climate finance is inadequate to prevent

current and future losses. Therefore, to avert, minimise, and address L&D, support and action, including finance need to be urgently mobilised.

Chapter 3 Research designs and methods

3.1 Introduction

Chapter 3 describes the philosophical underpinnings and methodological approaches to meet the research aim and questions presented in Chapter 1. Section 3.2 provides details on the research philosophy. Section 3.3 highlights the relevance of qualitative research methods and grounded theory employed in this study to examine social-ecological systems (SES) vulnerability, climate adaptation measures, and institutional processes to avert, minimise, and address climate change L&D in Fiji's sugar industry. Section 3.4 and 3.5 outlines the research strategy, that is, the use of ethnography and case studies and their relevance to this research. Information on data collection methods such as participant interviews, participant sampling, and document analysis is provided in Section 3.6. Section 3.7 discusses data analysis techniques in NVivo 12 Plus. Section 3.8 discusses researcher's positionality followed by research validity and reliability approaches and the chapter conclusion.

3.2 Research philosophy

The epistemological position of the researcher is essential in determining the use of research methods (Spencer, Pryce & Walsh 2014). Epistemology is the philosophy of knowledge and justification (Durant-Law 2005). It is concerned with nature and forms of knowledge (Scotland 2012). Epistemology is defined as "systematic consideration, in philosophy and elsewhere, of knowing: when knowledge is valid, what counts as truth, and so on" (Packer & Goicoechea 2010, p. 227). The two main research philosophies are positivism and interpretivism.

From an ontological perspective, positivism indicates that reality or objective truth is independent of our beliefs and can be ascertained through direct observations and experiences (Cupchik 2001; Wrona & Gunnesch 2016). Therefore, a positivist's stance is one of objectivism and is founded on data and facts that can be proven (Park, Konge & Artino 2020; Scotland 2012). Consequently, positivism values objectivity, proving or disproving a hypothesis through experiments, deductive reasoning, and application of quantitative techniques (Ryan 2018; Spencer, Pryce & Walsh 2014).

By contrast, interpretivism or constructivism indicates that knowledge is constructed by individuals through social interactions and modified through an interpretative process (Wrona & Gunnesch 2016). Constructivists believe that researchers individually and collectively construct meaning of phenomena under investigation (Teddlie & Tashakkori 2009). These meanings can be varied and multiple. Hence, the researcher often looks for complexity of views rather than narrowing meanings into a few pre-determined categories (Creswell 2009). Therefore, constructivism suggests that there are multiple versions of knowledge since it is a product of construction between the "known" and "knower" (Yazan 2016). Constructivism advocates for qualitative techniques such as interviews, focus groups, and participant observations (Creswell 2009; Harrison et al. 2017; Yazan 2016).

Positivism and constructivism paradigms can be integrated to give rise to pragmatic or soft constructive paradigm. Pragmatism has its origin in constructivism and post-positivism (Harrison et al. 2017). Pragmatism emphasises that integrating research methods from a positivist and constructivist paradigms is necessary to provide a holistic understanding of the phenomena under investigation (Creswell 2014). Morgan (2014) emphasised that pragmatism

can serve as a philosophical program for social research regardless of whether the research uses qualitative, quantitative, or mixed methods. Hence, pragmatism can be applied to qualitative social science research because it is neither as rigid as positivism nor as flexible as constructivism (Harrison et al. 2017; Morgan 2014; Yazan 2016).

This research is epistemologically grounded in pragmatism and social constructivism. This thesis adopts a modified pragmatic grounded theory to explicitly understand experiences and governance of climate change L&D in Fiji's sugar industry (further discussed in Section 3.2.1). This research also utilises social constructivism where the researcher and the respondent co-create understanding (Denzin & Lincoln 2011). Social constructivism helps to construct appropriate meanings from data and provides a thick description of the situation, issues, and potential responses. For these reasons, this research employs a pragmatic and a constructivist approach to gather perceptions and rich experiences of stakeholders to understand, construct social meaning, and interpret experiences of climate change vulnerability, climate adaptation, and L&D from cyclones and droughts in Fiji's sugar industry.

3.3 Qualitative research

Qualitative research is a field of inquiry that cuts across discipline, field, and subject matter (Denzin & Lincoln 2011). Qualitative research is an "inductive, interpretive, and naturalistic approach to the study of people, cases, phenomena, social situations, and processes in their natural settings in order to reveal in descriptive terms the meanings that people attach to their experiences of the world" (Yilmaz 2013, p. 2). It is a form of social research which explores phenomena, accumulates knowledge of human behaviour and beliefs, and tries to construct meaning from a social experience (Alshenqeeti 2014; Mohajan 2018).

The primary aim of qualitative research is to explore a topic in-depth often through the use of in-depth interviews, focus group interviews, and participant observations. It aims to understand how participants derive meaning from their surroundings by exploring perceptions, beliefs, opinions, and attitudes (Cleary, Hayter & Horsfall 2012). Qualitative designs also need to stay flexible, iterative, and emergent to explore new emerging ideas (Coyne 1997). The flexibility of qualitative research and its ability to adapt to various research settings are regarded as particular strengths of qualitative methods (Gilmore & Carson 1996; Daly et al. 2007).

In contrast to quantitative research, qualitative research often aims to construct meaning through an inductive process. In inductive analysis, the researcher allows theories to emerge from the data without any constraints imposed by a structured methodology (Thomas 2006). The researcher works back and forth between the themes and the data set until a comprehensive set of themes are established (Creswell 2014). Qualitative research is based on narrative reporting (Erickson 2011) with thematic analysis using a variety of inductive and iterative methods, including categorical and contextualising strategies (Teddlie & Tashakkori 2009). Inquiry extends to all phases of research, from framing the research question to methods and data collection, interpretation of findings, reflection, and communication of research to the audience (Cupchik 2001).

Climate change studies have used qualitative inquiry widely in the PICs, including Fiji, to provide insights into people's experiences with climatic events and adaptation measures

(Dumaru 2010; Gero et al. 2011; Lata & Nunn 2012; McNamara & Prasad 2014; McNamara & Jacot Des Combes 2015). This research similarly utilised a qualitative approach through the use of semi-structured interviews (SSI), field notes, observation, and document analysis (further discussed in Section 3.6). Multiple sources of information were employed to gather comprehensive data to explicitly understand climate change L&D in Fiji's sugar industry. The interviews generated data to assist in understanding human-environment interactions, SES vulnerability, implementation of adaptation measures, and the resulting L&D. Field observation was employed to understand practices of Indo-Fijian sugarcane farmers. Policy analysis highlighted institutional challenges to mobilise resources, address L&D, and recommended ways to enhance action and support to address L&D.

3.3.1 Grounded theory

Grounded theory is one of the most widely used frameworks for qualitative research (Bryman 2012). Grounded theory outlines a process of methodological inquiry in which the researcher develops a general abstract theory of a process, action, or interaction grounded in the informants' perceptions (Creswell 2009). It has a long history in studies of social justice, social inequality and inequity, fairness and suffering among people, and individual rights (Charmaz 2011). Glaser & Strauss (1967, p. 1) developed a positivist grounded theory describing "how the discovery of theory from data-systematically obtained and analysed in social research - can be furthered." The authors continue to state that "grounded theory can be presented either as a well-codified set of propositions or in a running theoretical discussion, using conceptual categories and their properties" (Glaser & Strauss 1967, p. 31).

In contrast to Glaser & Strauss (1967), Charmaz & Bryant (2010), and Mills, Bonner & Francis (2006) emphasised a constructivist approach to grounded theory and considered the method as inductive, comparative, and interactive. Charmaz's constructive grounded methodology builds on the original theory by Glaser and Strauss and is aligned with interpretive inquiry with roots in social constructivism (Charmaz & Bryant 2010). Constructive grounded theory assumes that the researchers and participants are part of the research experience and aims to bring people's perspectives to the foreground (Charmaz 2017). Charmaz & Bryant (2010) believed that constructivist grounded theorist attempts to collect an insider's insights and gather extensive rich information about participants' lives and the world through sustained interaction. Researchers attempt to see the phenomena from the inside and co-construct meaning from interacting with the participants (Charmaz 2011). The knowledge created from this approach indicates depth of rich data, feeling, and reflexive thought (Mills, Bonner & Francis 2006a). The process of data collection is determined by emerging theories (Glaser & Holton 2004).

Ralph, Birks & Chapman (2015) building on Charmaz's earlier work summarised key elements of grounded theory methodology:

- Initial coding and data categorisation
- Memo writing
- Concurrent data gathering and analysis
- Constant comparative method
- Theoretical sampling
- Theoretical sensitivity
- Focused and axial coding

- Identifying core categories
- Theoretical coding
- Theorising

The three main strategies for applying grounded theory within research methods include coding, memo writing, and theoretical sampling (Charmaz & Bryant 2010; Charmaz 2015, 2017). In that respect, grounded theory is fundamentally an iterative process where the researcher goes back and forth with data collection and analysis because each is seen to advance the other over a period of time and knowledge development (Mills, Bonner & Francis 2006b; Charmaz 2017). This engages the researcher and s/he remains active as an engaged analyst (Charmaz 2011). In such a way, constructivist grounded theory is a form of interpretive enquiry (Gardner, Fedoruk & McCutcheon 2012). It encourages the researcher to ask critical questions from the beginning of data collection to the stages of analysis and writing (Charmaz 2017).

Grounded theory has been used to study farmers' responses to climate change (Fleming & Vanclay 2010), climate change adaptation (Biagini et al. 2014; Petheram et al. 2010; Raymond & Robinson 2013), gender vulnerability to food insecurity (Kakota et al. 2011) as well as urban resilience (Jabareen 2012). This thesis uses a modified pragmatic approach to grounded theory to fully understand, capture perceptions, and experiences of climate change L&D in Fiji's sugar industry. Pragmatic approach draws upon elements of both constructivism and post-positivism (Harrison et al. 2017) to interpret, categorise, manage information, and adapt findings to express clarity and applicability to the results (Haas & Haas 2002; Mills et al. 2017). While both a positivist and a constructivist approach can be used to explain a phenomenon (Harrison et al. 2017), a pragmatic approach, through robust research design, could be utilised for practical considerations, soft constructivism, norm-building, and is contributed to a strong and more confident knowledge claim in social sciences (Haas & Haas 2002). Therefore, drawing on both elements of constructivism and post-positivist, this research assumes that reality is inter-subjectively constructed through meanings that are developed socially and through experience.

3.4 Ethnographic approach

The research objectives require insight into the human dimension of research phenomena. To provide a well-tested methodology, ethnography was used to complement grounded theory. The roots of ethnography lay in cultural anthropology and focused on small-scale societies and their concern with nature, construction, and maintenance of culture (Goulding 2003). Ethnography aims to describe life as it is lived and experienced by people (Ingold 2017). The ethnographic approach is theoretically oriented, that is, it modifies older theories and develops new theories (Morse 2016). In this sense, it is akin to grounded theory, though a more significant reference to prior theory. Indeed, it is recognised that ethnography has formed the basis of grounded theory and ethnographers make connections between events by using grounded theory to study processes (Morse 2016).

Bamkin, Maynard & Goulding (2016) emphasised that grounded theory and ethnography form a powerful complementary research tool where ethnography allows gathering research participants' perceptions and grounded theory provides a structural framework for comparing data and exploring the research topic in greater detail. Therefore, when combined, the two

methods provide greater detail than grounded theory or ethnography alone. Tavory & Timmermans (2009) pointed out that in grounded theory, theory is constructed from ethno-narratives which are lived experiences of people, as bounded by various structures and processes and is therefore intrinsically related to grounded theoretical approach.

There is no fixed way in which ethnography and grounded theory work together. Great flexibility allows the dual tool to be tailored to each particular piece of research. For example, in a recent study, Ploger & Barakos (2021) combined institutional ethnography and reflexive grounded theory to investigate transitional linguistic processes of newly arrived students in German educational system. The particular dual approach allowed the investigators to collect and analyse data in a systematic manner that was appropriate for the subject of what was being observed in a research site. The flexibility enabled methodological scaffolding to reconstruct experiences and to visualise voices and practises of social actors engaged in social transition of newly arrived students in Germany which one method would not have offered. Therefore, ethnographic methods in grounded theory allows the research to go deeper into the studied phenomena.

For this thesis, ethnographic research and grounded theory provided a scaffolding that enabled insights to be sought at various levels (community, sector level, and national level) as well as the interactions between each level. To understand the lived experiences, the researcher had prolonged direct contact with sugarcane farmers to understand the climate change experiences as farmers live and experience it. The researcher observed what was happening in the community to better understand social relations (relations within the community, between stakeholders, and between farmers and key stakeholders) and took notes on farmer's surroundings and agricultural practices. Key stakeholders from the sugar industry and academics were also interviewed to understand the institutional processes for addressing L&D. As a result, the scaffolding enabled the seeking of integrative, complex, and multi-dimensional research insights into climate change L&D and the processes and plans of the sugar industry to address L&D.

Overall, the ethnographic approach aimed to complement grounded theory throughout the research to provide a holistic approach. Prolonged observations and engagement in the field, interviews with key stakeholders, and data analysis led to theoretical development by identifying abstract categories and theoretical interpretations of lived climate change experiences and resulting L&D in the sugar industry of Fiji. The combined methodology of grounded theory and ethnography identified common threads for underlying vulnerability (both climatic and non-climatic stressors), barriers to adaptation, resulting L&D, and challenges to address L&D in Fiji's sugar industry.

3.5 Case study

Case studies have become one of the common ways to conduct qualitative inquiries (Stake 2005) and have been widely used in geography, psychology, sociology, history, education, and medical sciences (Flyvberg 2011). Willis, Jost & Nilakanta (2007, p. 238) described case studies as "an examination of a specific phenomenon such as a program, a person, a process, an institution or a social group." Yin (2003, p. 12) stated that case studies "illuminate a decision or a set of decisions: why they were taken, how they were implemented, and with what results." It is an empirical inquiry that enables the researcher to ask "how" and "why"

questions (Yin 2003). Case studies are generally inductive and flexible (Stake 2005), generating in-depth data to learn more about a phenomenon (Njie & Asimiran 2014).

Qualitative case studies allow researchers to examine complex phenomena within their context using various data sources (Baxter & Jack 2008; Boblin et al. 2013). Depending on the nature of the study, one or more of these data sources can be used (Njie & Asimiran 2014). These data sources include interviews, documents, and participant observation (Willis, Jost & Nilakanta. 2007). These varied sources of data are collected and analysed to create a holistic understanding (Boblin et al. 2013; Noor 2008) of a complex social phenomena (Yin 2003) with prolonged engagement in the field (Stake 2005).

Multiple case studies increase the research's robustness and the reliability and validity of results (Yin 2003). The advantage of using case studies is that it enables a holistic approach to gather rich data and supports the idea that much of human behaviour is best understood as lived experience in the social context (Willis, Jost & Nilakanta. 2007). The sample size of case studies is less important, rather importance is given to the nature of in-depth, quality, and rich data to be collected (Njie & Asimiran 2014; Wrona & Gunnesch 2016). The following section provides a rationale for the selected case.

3.5.1 Selection of case studies

Various climate change case studies have been conducted in the PICs to study vulnerability and resilience of the islands and for policy development (Dumaru 2010; Dreher & Voyer 2014; Kelman 2014, 2018b; Mercer 2010). A multi-case study approach was employed in this thesis to gain an understanding of climate change L&D in Fiji's sugar industry. Field research was undertaken in two Indo-Fijian sugarcane communities in Western Viti Levu, Fiji (Figure 3.1). These communities are located near the main highway for easier access. The two settlements included:

- Barotu settlement: located in Rakiraki, Ra Province,
- Toko settlement: located in Tavua, Ba Province.

Indo-Fijian settlements are usually small clusters of two or three households, separated by distinct boundaries or fields with the overall settlement being largely scattered in an area (Anshuka et al. 2021a; Nakamura & Kanemasu 2020). The housing type mainly consists of corrugated iron with woods and few concrete houses. House extensions are typically common with adjacent rooms being an extension of the existing structure. Unsealed roads surround the settlements which is joined to the main road that leads to the town area. According to Anshuka et al. (2021a), Indo-Fijian communities are mostly self-reliant and have an inherent individualistic approach to disasters and lack communal assets such as land making them more vulnerable at a community level. Even though family and kinship ties are less pronounced in Indo-Fijian families, they still exist and families assist each other in times of need. For instances, remittances are an important form of support following high levels of migration (DFAT 2022).

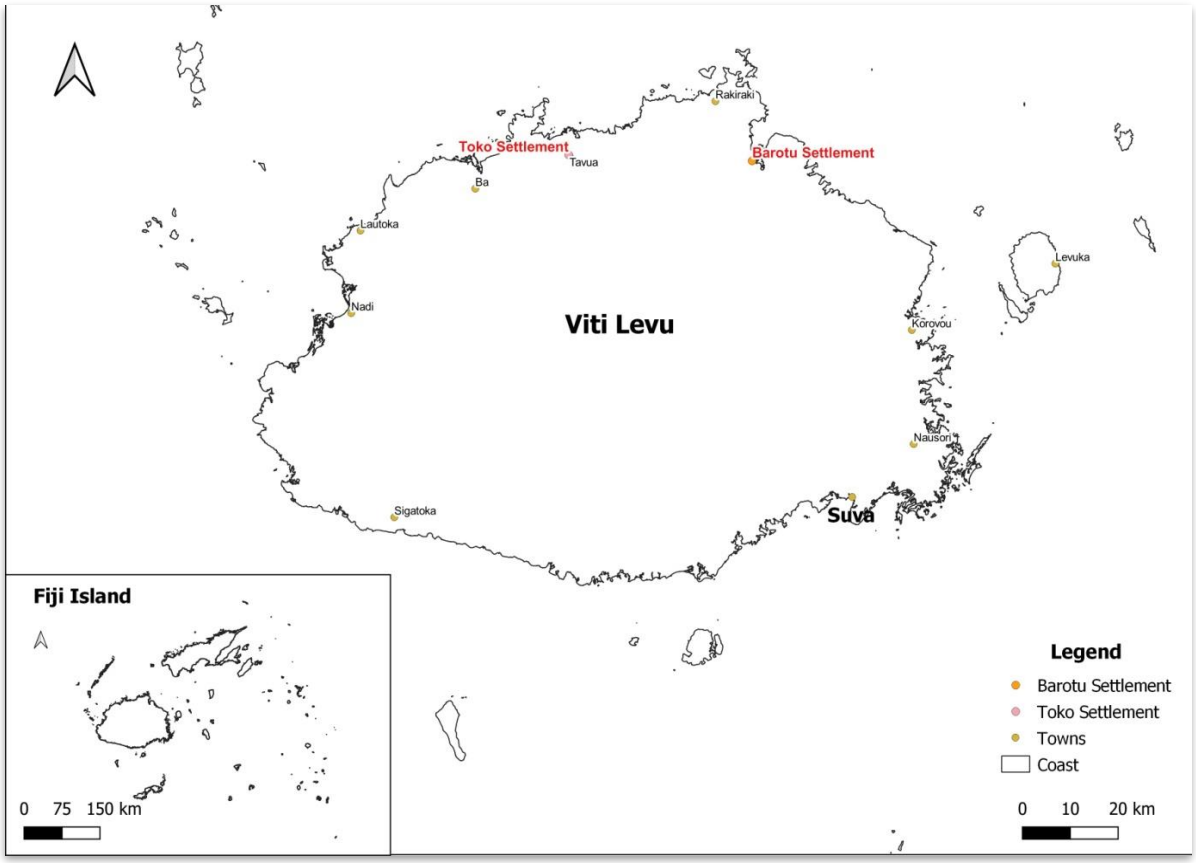

Figure 3.1 Locations of study sites

The province of Ra is located on the north of Viti Levu and is approximately 1341 square kilometres. Ra province has the third highest incidence of poverty among the 14 provinces of Fiji (Waqainabete-Tuisese 2016). A closer look at the Ra province suggests that 53 percent of the population live below the poverty line - a clear indication of the population's vulnerability to disasters (Brown, Daigneault & Gawith 2017). Most of the population in Ra province depend on the agricultural sector. On the other hand, Toko settlement is part of Tavua district located in Ba Province. The majority of the population in Ba province are also dependent on the agricultural sector. Tavua district is located on the Western Division on the northeast coast of the island of Viti Levu.

Barotu and Toko settlements were selected for research purposes because sugarcane farming is not only the primary source of livelihood for these farmers but also a way of life, as the practice of sugarcane farming has been passed down through the generations (Gawith, Daigneault & Brown 2016). Additionally, the two rural Indo-Fijian communities have been identified as vulnerable to sudden events (cyclones) and slow-onset events (drought) through post-disaster assessment needs (Esler 2016) and climate change studies (Brown, Daigneault & Gawith 2017; Koroiwaqa 2016). Both sites are located close to a river source and are prone to flash flooding during heavy rainfall and cyclones. Therefore, these case studies allowed for examination of SES vulnerability, perceived impacts and lived experiences of tropical cyclones and droughts on sugarcane farms, implementation of adaptation measures, resulting L&D, as well as measures undertaken by farmers and the government of Fiji to avert, minimise, and address L&D.

3.6 Data collection methods

Research methods are specific techniques and procedures used to collect and analyse data (Scotland 2012). Qualitative data collection methods include observations, interviews, focus groups, and collection and analysis of texts and images (Carter & Little 2007). In this research, interviews and document analysis were used for documenting and examining climate change L&D in Fiji's sugar industry. The gathering of qualitative data through a storytelling manner is culturally relevant for Pacific communities. The following section describes the data collection and data analysis techniques.

3.6.1 Qualitative interviews

Qualitative interviewing is a powerful method for interpretive inquiry (Charmaz 2006) to capture peoples' voices, experiences (Rabionet 2011), and perceptions in greater depth (Alshenqeeti 2014; Charmaz 2006; Kvale 2006). In-depth interviews allow a researcher to explore and become fully involved in the process, thereby gaining a better understanding of the social experience (Charmaz 2006). In-depth semi-structured interviews (SSI) are not restricted to specific questions, can be guided by the researcher (Anderson 2010), and is a common ethnographic technique (McCubbin, Smit & Pearce 2015). Considering the nature of this research, SSI were used to gain an in-depth insight on climate change L&D in Fiji's sugar industry. SSI is defined as a verbal exchange between the researcher and the informant in an attempt to elicit information (Longhurst 2010).

Before the interview was conducted, a list of key questions were developed to guide the researcher with the interview and also allowed for some flexibility in the process (Bryman 2012). This enabled the researcher to cover key areas of concern in the interview and allowed for in-depth discussion following important lines of inquiry. In addition, an interview protocol was developed for asking and recording interview questions. Free prior and informed consent was obtained from key informants (Robinson 2014). Interviews were organised with consideration of location and time to allow sufficient time for discussion. Each interview took around 60 minutes. An information sheet was provided to the key informants informing them of the purpose of the survey, how the data would be collected and used, the type of the data collected, and the duration of the interview. This allowed the participant to prepare well for the interview and provide supplementary materials for information collection purposes.

Furthermore, ethical considerations were also crucial for this research. In particular, this study was conducted in accordance with the Australian Code for Responsible Conduct of Research and according to the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018). Application for ethics approval for this research was made to the Human Research Ethics Committee of The University of Adelaide. Ethical approval was obtained before resuming this research (see Appendix 1). Accordingly, to protect the identity of the participants, the participants had complete anonymity throughout the study. The participants were only referred to by a pseudonym, for example, Barotu Farmer 1, while reporting the research results. The data collected from the interviews were not shared with anyone.

3.6.2 Participant sampling

Initially, qualitative research needs to identify appropriate participants who can best inform the research rather than be a statistical representation of a population (Ritchie, Lewis & Elam 2003). This form of sampling is called purposive sampling (Bryman 2012; Fossey et al. 2002; Creswell 2009, 2014). The key aim of purposeful sampling is to select and study a small

number of participants who can produce a wealth of knowledge and provide an in-depth understanding of the phenomena under study (Creswell 2014; Yilmaz 2013). In this research, a purposive sampling approach was initially used to identify small-holder sugarcane farmers and key stakeholders.

Interviews with sugarcane farmers were conducted from November 2019 to January 2020. Initial contact with farmers were made within the community. Twenty smaller-holder sugarcane farmers were purposefully identified and interviewed at each field site (Table 3.1). Farmers (both male and female) were selected based on the following criteria:

- Farmers must have resided in the community for more than twenty years, preferably thirty years
- Farmers' main source of income is sugarcane farming
- Farmers have been engaged in sugarcane farming for more than twenty years, preferably thirty years
- Farmers that were severely affected by recent cyclones and droughts

The interviews with farmers were conducted in informal settings, and mostly in or adjacent to their homes, to allow for a relaxed environment. This encouraged a *talanoa* (Fijian for storytelling) or storytelling based on the participants' experience and knowledge in dealing with cyclones and droughts. A *talanoa* is a process where two or more people talk together, where one person tells a story while the other listens (Pearce et al. 2020). In-depth SSI was conducted with farmers regarding exposure to cyclones and droughts, the impact of cyclone and droughts on their farms, adaptation measures implemented by their household, and the resulting L&D (see Appendix 2 for interview guide). A blend of close-ended and open-ended questions were asked, followed by "why" and "how" questions to gain more insights on particular topics. The interviews were audio-taped and a journal was used for memo writing to further help the data analysis process (Creswell 2009; Mills, Bonner & Francis 2006a). Where the participants did not allow audio recording, the researcher took notes. The researcher took assistance from a field guide while visiting farmers for an interview.

Furthermore, a total of twenty-eight key stakeholders were interviewed between January 2020 - January 2021 (refer to Table 3.1). The key stakeholders were purposefully identified from relevant government ministries such as the Ministry of Sugar Industry, the Ministry of Agriculture, the National Disaster Management Office (NDMO), SRIF, agriculture extension officers, academics, and climate change experts. These stakeholders were selected based on their roles and expertise in climate change L&D, climate adaptation and disaster risk, and broader policy formulation. Initial contact with the participants was made through an email. Interviews with government officials were conducted at their workplace in English, with questions developed from the improved understanding of L&D emerging from deliberations within local rural communities. The context of the interview varied according to the key informant's background and area of expertise. In-depth SSI was conducted regarding impacts of cyclones and droughts on the sugar industry, effectiveness of the current policies and institutional frameworks to address climate change L&D in the sugar industry, measures to enhance action and support to address L&D, and challenges faced by the sugar industry of Fiji to avert, minimise, and address L&D. Apart from purposive sampling, theoretical sampling was also conducted to gain more insight and fill knowledge gaps.

Charmaz (1996, p. 45) stated that "by the time you need to conduct theoretical sampling, you will have developed a set of categories that you have already found to be relevant and useful to explain your data. After you decide that these categories best explain what is happening in your study, treat them as concepts." Theoretical sampling aims at theory construction by collecting key data relevant to the study (Charmaz 1996, 2006, 2012). By identifying gaps in theory, the researcher moves to the next sources of data collection (Glaser & Holton 2004). For this study, theoretical sampling further identified key stakeholders for interview. Each participant was targeted to provide information on the impacts of cyclones and droughts, adaptation measures implemented in the sugar industry, policy and plans in place to avert, minimise, and address L&D, and mobilisation of resources such as finance, technology, and expertise. Interviews at the community, district, sub-national, and national strategic levels generated an integrated chain analytical approach for comprehensively understanding L&D from cyclones and droughts in Fiji's sugar industry. By doing so, research objectives 1, 2, 3, and 5 were addressed.

Sampling in qualitative research continues until themes emerging from the data, are well developed and no new information emerges (Fossey et al. 2002; Bryman 2012; Creswell 2009, 2014). This is called the point of saturation. Qualitative research requires having a small sample (Creswell 2014) because of the detailed and intensive work required in the field (Anderson 2010) and gathering an in-depth understanding of phenomena (Dworkin 2012). A study by Guest, Bunce & Johnson (2006) suggested that theoretical saturation may be evident at 6-12 in-depth interviews. To per-determine the sample size may be a futile task as sample sizes are not determined by hard and fast rules but by factors such as depth and duration of the interview and what is relevant to the interviewer (Britten 1995). The table below shows the sampling size at each field site and the sampling size of key stakeholders.

Table 3.1 Number of interview participants

Farmer Participants	**Male**	**Female**	**Total**
Barotu settlement	14	6	20
Toko settlement	15	5	20
Key Stakeholder participants	18	10	28
	47	21	**68**

To explicitly understand and analyse L&D in Fiji's sugarcane communities, this thesis will use Pearce et al. (2018) vulnerability framework to examine vulnerability in Indo-Fijian sugarcane communities, namely; Barotu and Toko settlements. The vulnerability framework used by Pearce et al. (2018) is similar to the vulnerability model developed by IPCC (2007, 2014). This framework serves as an appropriate starting point for vulnerability analysis because it has been used in many vulnerability studies in the PICs, including Fiji (Currenti et al. 2019; McCubbin, Smit & Pearce 2015; Pearce et al. 2018; Shabina et al. 2021).

Additionally, this thesis will utilise the conceptual framework developed by van der Geest & Warner (2015) to examine and analyse current adaptation practices, adaptation limits and barriers, and L&D from sudden and slow-onset events in the Fijian sugar industry. The justification for employing this conceptual framework is because many scholars have adopted this framework to examine L&D in various vulnerable countries (Monnereau & Abraham

2013; Warner & Afifi 2014; Yaffa 2013). Also, this thesis aims to examine various categories of L&D (avoided, unavoided, and unavoidable) proposed by Verheyen & Roderick (2008) in Fiji's sugar industry. By studying various categories of L&D, this thesis will highlight opportunities for policy, planning, and funding mechanisms for addressing L&D within the sugar industry of Fiji.

3.6.3 Document analysis

Document analysis is a social research method involving a systematic review or evaluation of printed and electronic documents. Document analysis aims to examine and interpret data to construct meaning, gain understanding, and enhance knowledge (Bowen 2009). Atkinson & Coffey (1997) believed that documents are social facts that are produced, consumed, shared, and used in socially organised ways. Dalglish, Khalid & McMahon (2020) stated that documents exist within social "field of action" - a term used to describe environments within which individuals interact. Therefore, documents are not simply records of life but agents in their own right.

Documents take a variety of forms and include text and images, with text being the most common form of qualitative data analysed in social science research (Mackieson, Shlonsky & Connolly 2019). Text documents include advertisements, meeting minutes, background papers, journals, letters, and public records (Bowen 2009). Charmaz (2015, p. 1612) noted that "texts and images are useful to challenge assumptions about the objectivity of documents and create teachable moments about how we read documents and whose and what purposes they serve."

The process of document analysis is iterative and includes finding, selecting, appraising, and synthesising data (Bowen 2009). Document analysis includes data such as quotes or entire passages that are organised into themes and categories through thematic analysis (Bowen 2009). Analysis of documents can be used to contextualise data, generate new interview questions, supplement research data, monitor changes and development, verify findings from other sources (Bowen 2009). Therefore, document analysis is often used with other data collection methods to support data triangulation and theory building (Bowen 2009; Mackieson, Shlonsky & Connolly 2019).

Document analysis is also useful for understanding policy, documenting processes, and understanding how ideas are presented formally (Dalglish, Khalid & McMahon 2020). Mackieson, Shlonsky & Connolly (2019) noted that document analysis of official government documents and records serves as highly trustworthy documentary data that increases rigour, transparency, and reduces potential biasness in qualitative research. This research analysed relevant government policies, plans, and reports that aimed to drive urgent climate action, reduce disaster risks, and increase resilience of communities. Table 3.2 provides a list of documents that were analysed.

Document analysis in this research was used to complement interview data and to aid understanding of how climate change L&D is prioritised in Fiji. The documents analysed also provided background and historical information on how policies have been developed and revised to meet the increasing needs of climate change. More importantly, document analysis provides an overview of L&D governance, that is, how national policies and priorities are being mainstreamed at the sectoral level to mobilise resources to address climate change L&D

at the community level. Thematic analysis was used to analyse these documents. Information was organised into categories related to the research questions. By doing so, the researcher could identify important sections of the documents and understand its relevance to the research. Through document analysis, research objectives 4 and 5 were achieved.

Table 3.2 Documents and data analysed

	Document	Information analysed
National Level documents	Fiji's National Climate Change Policy 2018-2030	Recognition of climate change L&D and affirmative action and support to avert, minimise, and address L&D
	National Disaster Risk Reduction Policy 2018-2030	Identification of DRR initiatives for the sugar industry
Ministry of Sugar Industry documents	The Sugar Industry Act 1984, Sugar Research Institute of Fiji Act 2005, and Master Award	Mainstreaming of climate change and DRR into sectoral policies
	FSC Annual Reports	Sugarcane yield and related data

3.7 Data analysis

The analysis of the research data took form of narrative and thematic analysis which included identification, analysis, and reporting of themes within the data set. The interview and transcription went hand in hand. The interviews from Barotu and Toko settlements were conducted in Hindi. Care was taken to translate these interviews from Hindi to English by the researcher, to ensure that the translation did not misinterpret or lose meanings attached to the interviews. Once the transcription was completed, it was read through thoroughly (Creswell 2014). This process was a reflective process and included coding (Alshenqeeti 2014), categorising (Charmaz 2012), and recapitulating cultural themes (Kvale 2006).

Grounded theory has two coding phases: (a) initial coding and (b) focused coding (Charmaz 2006). Through initial coding, the researcher remains open to exploring theoretical categories (Charmaz 2006). Data analysis included "constant comparison" method where interview texts were analysed line by line, themes were noted, and subsequently compared with other transcripts to ensure consistency and also identify negative cases (Charmaz 2012; Goulding 2003; Kenny & Fourie 2015). This process assigns labels to concepts, ideas, and constructs that arise from the data (Carmichael & Cunningham 2017). Focused coding was the second step in coding. Focused coding was conducted with NVivo 12 Plus and used to categorise the data using the most significant and frequent appearing codes (Charmaz 2006). These categories or common threads later developed themes which appeared as major findings of the research and were connected to each other to develop a theoretical framework (Creswell 2014).

The final step of the analysis involved interpreting the findings and lessons learnt (Creswell 2014). The interpretation was supported by direct quotes from the interview. Direct quotations from the interview helped describe participants' feelings and experiences. Quotation from the interview was extensively used throughout the thesis to provide rich descriptions of emerging themes. Therefore, knowledge was co-produced by interpreting experiences and knowledge of

the participants. As a result, the researcher was able to examine and develop wider understanding of the research phenomenon.

Additionally, document analysis was conducted manually. National-level climate change and disaster risk policies were analysed based on their objectives and outcomes. Policies from the Ministry of Sugar Industry were also examined to understand the degree to which climate change information has mainstreamed into policy and action in the sugar industry. Direct quotes from the interviews were integrated with text from national and sectoral policies to further provide evidence of processes and plans implemented to address L&D.

3.8 Researcher's positionality

Researcher's positionality describes an individual's worldview and the position they adopt in relation to a research in its social and political context (Holmes 2020). Positionality influences how research is conducted, its results, and its outcomes (Rowe 2014). Some aspects of positionality are culturally ascribed such as gender, race, skin-color, and nationality while others such as political views, personal life-history, lived experiences are more subjective and contextual.

The positionality of the researcher could influence the participants interest in participating in interviews. For this research, the social standing of an "educated" female attending university abroad in Adelaide, initially created distance between the researcher and the farmers selected for interviews. However, social protocols were followed such as greeting the farmers in the traditional manner and wearing a culturally appropriate outfit which allowed for an ease in the environment. Research has shown that abiding by cultural protocols creates a comfortable atmosphere between the researcher and the participants (Mero- Jaffe 2011).

Some farmers were eager to participate because they wanted their "voices to be heard". On the other hand, the researcher felt that some male farmers were not comfortable talking to a female researcher. Female farmers were also hesitant to participate because they were shy and thought their contributions would not be significant. Hence, at the beginning of the interview, the researcher spend time talking to the farmers and building trust. The researcher also assured the farmers that their local knowledge, observations, and lived experiences are important for this research and would be used to understand local climatic and non-climatic risks and developing policies. Therefore, the researcher made sure that the questions were properly explained to the farmers and minimised the use of technical jargons. Being a Fijian citizen of Indian descent and the researcher's family background in sugarcane farming allowed for openness and a conducive atmosphere for a friendly discussion and made the researcher not feel like an "outsider".

On the other hand, the researcher's role as a PhD candidate at an Australian University was viewed positively by other stakeholders. There was a general willingness among stakeholders such as government official to participate in the research and make a significant contribution. This is because this is the first climate change L&D study in Fiji's sugar industry. The government officials also offered to share supplementary information such as national reports.

3.9 Qualitative validity and reliability

The validity of research findings occurs throughout the research (Creswell 2014). To enable validity and to reduce bias, this research employed multiple approaches such as use of SSIs

(Gioia, Corley & Hamilton 2012), prolonged engagement in the field, field observations, literature review (Creswell & Miller 2000; Morse 2015), document analysis, and triangulation (Corley 2004; Armour, Rivaux & Bell 2009). Qualitative validity of the research findings depends on trustworthiness, authenticity, and credibility. The process of validity ensures the accuracy of the research findings (Creswell 2009, 2014), that is, whether the findings were accurate from the point of view of the researcher, participants, and the readers (Creswell & Miller 2000).

Triangulation was used to validate research design and method. Methodological triangulation involved the use of three different data collection methods (Willis, Jost & Nilakanta. 2007). "The rationale for this strategy is that the flaws of one method are often the strengths of another and by combining methods, observers can achieve the best of each, while overcoming their unique deficiencies" (Willis, Jost & Nilakanta. 2007, p. 219). In this research, methodological triangulation included use of SSI, observations, case studies, and document analysis. Finally, although the researcher was required to investigate using a neutral stance there maybe unconscious bias in the research design and questions (Morse 2015).

Qualitative reliability ensures that the researchers' approach is consistent with other researchers (Creswell 2009, 2014). Both validity and reliability are intended to make research rigorous. Rigour or trustworthiness of qualitative research is the degree to which researchers can be held accountable for standards of inquiry that challenge the credibility of a research findings (Armour, Rivaux & Bell 2009). The rigour of qualitative studies was demonstrated by methodological thoroughness, prolonged engagement in the field, reporting on voices of the informant as well as the researcher.

3.10 Conclusion

This chapter provided details on the research design and methods of data collection employed to examine climate change L&D in Fiji's sugar industry. A brief description of the case studies was provided and their relevance for this research. This research used a qualitative case study approach and used multiple sources of data collection such as interviews and document analysis. Triangulation was used to increase the validity and reliability of the results. Results from this research will be presented in chapters 4 to 7. Finally, the results will be used to highlight the importance of transformation adaptation and support and action required to assist Fiji's sugar industry to avert, minimise, and address L&D (discussed in Chapter 8).

Chapter 4 Vulnerability to cyclones and droughts in Fiji's sugarcane communities: A case study of Barotu and Toko Settlements

4.1 Introduction

As a starting point of analysis, this research uses the vulnerability approach outlined by Pearce et al. (2018) (as discussed in Chapter 2, Section 2.3.4) to document vulnerability in the two Indo-Fijian settlements. According to Pearce et al. (2018), vulnerability is conceptualised as a function of exposure to bio-physical events, sensitivity to these exposures, and the adaptive capacity to deal with these exposure-sensitivities. The same framework will be used here to address research objective one which is to document the vulnerability of Fiji's sugarcane communities to sudden and slow-onset climatic events.

Using qualitative data from both settlements, the chapter begins by explaining the current status of the communities in relation to farming and livelihood systems and describes the socio-historical context which is referred to here as the social and ecological foundations. The chapter then discusses exposure to bio-physical events such as changes in weather, exposure to floods, and changes in intensity and frequency of cyclones and droughts. Section 4.4 documents climate-sensitive livelihoods followed by impacts of cyclones and droughts in Sections 4.5 and 4.6 respectively. The chapter then discusses the adaptive capacity of farmers through access to livelihood assets, traditional knowledge, and access to climate change information in Section 4.7. The chapter conclusion is presented in Section 4.8.

4.2 Social and ecological foundations

According to Chandra et al. (2017), Pearce et al. (2018), and Smit & Wandel (2006), broader social, political, ecological, and economic conditions affect elements of vulnerability, that is, exposure, sensitivity, and adaptive capacity. The facets of social, political, ecological, and economic conditions have been recognised by many scholars to include social and ecological well-being, socio-economic conditions, socio-historical settings, livelihood systems, geographical location, social cohesion, cultural aspects, gender, and traditional knowledge (Currenti et al. 2019; Pearce et al. 2018; McNamara & Prasad 2014). This research recognises the above features as integral components of SES vulnerability, and they are referred to here as the 'social and ecological foundations' of the system to be analysed. Building on Smit & Wandel (2006), this research defines social and ecological foundations as the current state and well-being of social and ecological dimensions. As part of the social and ecological foundations, this research begins by documenting local farming and livelihood systems, and the socio-historical context as witnessed in both Barotu and Toko settlements.

4.2.1 Farming and livelihood systems

The field research was undertaken in two Indo-Fijian sugarcane communities in Western Viti Levu, Fiji. These communities are located in Rakiraki (Barotu settlement) and Tavua (Toko settlement). Barotu and Toko settlements are selected for this study as they have been continuously affected by severe tropical cyclones and droughts in recent decades. Consequently, this allowed for an examination of cyclone and drought vulnerability in both settlements. Agriculture is the primary livelihood activity for the majority of households in Barotu and Toko settlements. The majority of participants have lived in these settlements for more than 50 years and have engaged in sugarcane farming for more than five decades. Sugarcane farming is not only their primary source of livelihood but has been part of their family's history.

Apart from sugarcane farming, farmers are also engaged in what they refer to as 'cash crop farming' which is small-scale horticulture and have few livestock. Lack of formal irrigation was noted in both settlements. Field observations indicated that farmers in both settlements have their larger plots allocated to sugarcane farming which is located near the main road for easy access during harvesting period. Smaller plots are located for cash crop farming, mostly in close proximity to a river, due to the lack of a formal irrigation systems.

The data from both settlements indicate that the main source of income for households is sugarcane farming. Barotu Farmer 19 said, "*I have been a farmer for 50 years. I have a sugarcane farm for my household income*." Toko Farmer 5 added, "*I lived here for 45 years, and I have been a farmer for 45 years. The main source of income is from sugarcane farming*." However, in recent years, farmers have diversified into cash crop farming to supplement household incomes. The interview revealed that "*farmers have started to focus towards cash crops*" such as "*okra, pumpkin, tomatoes, bean*" (Barotu Farmers 2 and 18). This is because "*three months of hard work in cash crop fields can earn the same amount as six months of hard work in the sugarcane field*" (Toko Farmer 3). Toko Farmer 20 explained, "*When we have cash crops, we have a source of income in the house regularly. From this, we can pay our bills and buy food.*" Another reason why farmers have switched to cash crop farming is because sugarcane farming has become less profitable "*because the cost of cutting cane has increased drastically*" and "*it is hard and expensive to find labour*" (Barotu Farmer 1 and Toko Farmer 8).

Additionally, in both settlements, livelihood diversification is driven by the need to earn additional household income because "*the cost of everything including the fertiliser is too high*" and farmers have to provide basic needs for their families and overcome the high cost of sugarcane production (Barotu Farmer 20). While livelihood diversification can build resilience, it can also be argued that diversifying into cash crops which is another form of climate-sensitive livelihood, could further enhance climate risks on farmers' current livelihood strategies making the current system more vulnerable to climatic stressors.

Moreover, given the old age of sugarcane farmers, farmers from both settlements were unable to seek off-farm employment to diversify their livelihoods. The majority of farmers stated, "*I am too old*" and "*I cannot work outside*" (Barotu Farmers 1 and 5). Women farmers from both settlements also considered off-farm employment. However, women farmers from both communities revealed that "*old age*", "*lack of education*", and "*household and farm commitments*" prevented them from seeking off-farm employment (Barotu Farmers 10 and 20, and Toko Farmer 17). As a result, sugarcane farmers are marginalised due to limited off-farm employment opportunities and have no option but to intensify their agricultural production to maintain a regular flow of income and food into the household.

As mentioned above, the majority of sugarcane farmers are over 50 years old. In the coming years, these farmers would be too old to work in sugarcane fields. According to Prasad (2019), 79 percent of farmers in the sugar industry are above the age of 50 years. While it is anticipated that the younger generation will continue with sugarcane farming, in both settlements, the younger generation is relatively less committed to the sugar industry after realising that old sugarcane farmers have "*been working hard to earn money from sugarcane but the return is not there*" (Toko Farmer 3). As a result, the younger generation has received formal education and is engaged in off-farm employment that offers "*medical insurance, and*

Fiji National Provident Fund (superannuation fund). Farming does not offer any of these" (Barotu Farmer 14). Toko farmers explained:

> The younger generation has moved away from agriculture. Some have migrated abroad while others have looked for employment outside. Even my sons are employed and do not want to work in the farm (Toko Farmer 7).

> A lot of youths are becoming educated and moving out. The younger generation is no longer interested in farming. They want to work in goldmines and work in the town (Toko Farmer 20).

The results indicate that sugarcane farming is the main source of income for farmers from both settlements. However, due to rising costs, lack of profit from sugarcane production, and the need to earn extra income, farmers are slowly moving from a conventional livelihood strategy (sugarcane farming) to diversified livelihood strategies (sugarcane and cash crops). Regardless, both of these are highly exposed to cyclones and droughts and are climate-sensitive livelihoods (as discussed in Section 4.3). Moreover, the older generation is unable to seek off-farm employment to further diversify their livelihood. As a result, the older generation is continuing with sugarcane farming and have intensified their agricultural production to maintain a regular flow of income and food into the household. The younger generation is moving away from sugarcane farming and seeking off-farm paid employment.

4.2.2 Socio-historical context

The three major land tenure systems in Fiji are Freehold (privately owned), State (government-owned), and *iTaukei* land (communally owned). Except for Freehold land, land cannot be sold permanently in Fiji. Individuals can obtain rights to land through formal land leasing arrangements. The Agricultural Landlord and Tenant Act of 1967 allows for State and *iTaukei* land to be leased for 30 years for agricultural purposes (Kumari & Nakano 2016). One-third of the *iTaukei* land is classified as a Native reserve and cannot be leased out to non-Fijians (Prasad & Tisdell 2006).

Land tenure issues are arguably the most contentious policy issue in Fiji (Kurer 2001b; Trnka 2005). Due to the short-term land lease agreements and lack of options for land lease renewal after expiry, land lease expiry and land tenure issues have consistently arisen, affecting the sugar industry (Lal, Lim-Applegate & Reddy 2001; Mahadevan 2007; Singh 2020). As the residents of both settlements are Indo-Fijians, land has been leased to them under formal land leasing arrangements. In Barotu settlement, the majority of land lease is issued by the Catholic church and is under the status of Catholic mission while some farmers are leased *iTaukei* land.

Since land tenure is a very sensitive issue, many farmers hesitated to participate in land tenure discussions. However, farmers disclosed that "*we used to pay premium before but now we pay rental*" and "*land lease [rental] has increased by 100 percent*" (Barotu Farmers 19 and 1). Barotu Farmer 3 highlighted:

> I have 7.5 hectares of Catholic mission land which has been leased out to us. We have to pay rental for this land. Currently, we are waiting for the land lease, and we have to pay FJ$15,000 for 30 years.

Apart from high rental costs, farmers from Barotu settlement also face land tenure insecurity. The Indo-Fijian tenants face great uncertainty with their land lease as in most cases they are unaware if their land lease will be renewed or if they would become landless (Reddy & Lal 2002). The uncertainty related to land tenure and the potential threat of needing to leave their home and land behind increases farmers' sensitivity and can overwhelm farmers. Farmers raised concerns that "*with insecure land tenure, we are unsure what to do*" (Barotu Farmer 1). Barotu Farmer 14 further explained:

> Currently, I have two years of lease left. The challenge I face here is whether my landlord will give me the lease. If I don't get the lease, then I will have to leave farming and look for a job. We have to think of our future.

Due to land lease expiry, Barotu farmers mentioned that the majority of farmers from Barotu settlement had to "*leave farming and relocate elsewhere*" (Barotu Farmer 19). Therefore, in addition to sugarcane farmers switching to cash crops, and the younger generation leaving sugarcane farming, the likelihood of farmers exiting the sugar industry is further increased due to insecure land tenure. "*I would say that almost 40 percent of the people have left and only 60 percent remain in this area to continue farming*" (Barotu Farmer 8).

Additionally, in Barotu settlement, insecure land tenure has led to controlled development and constrained long-term investment in farming. For instance, long-term investments could be seen as a waste of time and resources if farmers have to give up their land in the short-term. Barotu farmer 14 shared his pragmatic view, "*If I take [adaptation] measures on my farm [for cyclones and droughts] and if the land is taken from me, then it is just a waste*." The findings reveal that in Barotu settlement land tenure insecurity is one factor that influences implementation of climate adaptation measures. As a result, insecure land tenure in Barotu settlement limits adaptive capacity and increases SES's vulnerability to climatic risks. In line with these research findings, recent research by IPCC (2019) and Murken & Gornott (2022) highlighted that insecure land tenure affects the ability of vulnerable households and communities to advance climate change adaptation and mitigation measures.

In contrast to Barotu settlement, Toko settlement had longer land lease arrangements. Toko farmers disclosed longer-term "*Native land lease status with a 99-year lease*" (Toko Farmer 18). Toko Farmer 3 said, "*I have 30 hectares of farm and the landholding status is a 99-year lease*." However, in Toko settlement, lack of continuous climate adaptation measures were noted (as discussed in Chapter 5). Therefore, the findings reveal that in Toko settlement, land tenure security does not play such a critical role in implementation of climate adaptation measures.

4.3 Exposure to bio-physical events

Changes in climate have accelerated bio-physical hazard risks for human settlements (Fisher 2011). Exposure to bio-physical stressors refers to the presence of people, livelihoods, and assets being subject to harm and reflects the bio-physical characteristics of the stressor relative to the location and nature of the system (Pearce et al. 2018). To understand exposure to bio-physical events, this section examines the interaction between farming communities and exposure to changes in weather, floods, cyclones, and droughts. Similar trends of exposure to bio-physical events were noted in both settlements which are discussed below in more detail.

4.3.1 Changes in weather

Perceived changes in weather included hotter days, intense and short rainfall duration, changes in season, and longer dry periods. As expressed by Barotu Farmer 14, "*Some changes in weather have been noticed. It is too hot these days. It gets hotter and then we get severe cyclones. When it rains, it rains heavily*." Similarly, farmers from Toko settlement also perceived changes in weather patterns such as hotter days, changes in rainfall, and changes in the occurrence of drought. According to Toko Farmer 1, "*Yes, there has been a lot of changes in the weather. We are experiencing hot days*."

The weather changes are also affecting farmers' income. Barotu Farmer 8 stated, "*At times, there is a lot of rain, and we get a flood. We lose our income*." Toko Farmer 9 also pointed out, "*Yes, at times, there is heavy rain. One year we planted $20,000 worth of cabbage which all started to rot, and we lost everything. This year, I managed to plant few cabbages*."

Farmers from both settlements raised concerns that the "*seasonal calendar has changed*" and "*it has become hard to forecast the seasons*" (Barotu Farmer 2 and Toko Farmer 8). In the past, due to distinct wet and dry seasons, farmers were aware of what to cultivate in each season. However, the majority of farmers agreed that the seasons have become unpredictable. Barotu Farmer 15 explained:

> The seasons do not go according to the calendar, and we end up losing all our crops. This is something new. We did not experience this before. Previously, we used to plant according to the wet and dry season, and we were sure that this would grow but this is not the case now.

Changes within the dry and wet seasons were also experienced in both field sites. Since both settlements lack formal irrigation systems, there was a growing concern among farmers regarding changes in rainfall patterns. Toko Farmer 19 said, "*This is the rainy season but we are still waiting for rain.*" The wet season rainfall was also perceived to be erratic. Barotu farmer 5 stated, "*In the wet season, there will be short, intense rainfall or otherwise it will be dry*."

The majority of farmers from Barotu settlement explicitly discussed perceived changes in weather as a result of climate change. Barotu Farmer 18 reflected:

> Climate change is bringing about changes that we are experiencing. Now, we are experiencing hotter days and colder nights. It is very hot and there is a lot of heat. There is less rain but intense rainfall periods. Dry months are also longer now.

Barotu Farmer 7 pointed out:

> I think climate change has brought about these changes that we and the whole world is experiencing. Due to this, we are experiencing unpredictable rainfall and unpredictable weather patterns here.

While farmers from Toko settlement did not directly link the changes in weather to climate change, they considered the changes in weather "*not normal*" and "*not witnessed in the past*" (Toko Farmer 7). Toko Farmers 5 and 7 explained:

> Yes, there is a lot of difference. The difference is that we get hit by floods, droughts, and cyclones. This was not the case before. Nowadays, there are a lot of floods, a lot of droughts, and too many cyclones (Toko Farmer 5).

> Yes, we have noticed a lot of changes in the weather. It is hotter now compared to the past. The weather has become so unpredictable. No, this is definitely not normal. The changes in the weather are not normal (Toko Farmer 7).

The findings indicate that farmers from both settlements observed changes in weather as hotter days, short and intense rainfall, and longer dry periods. The exposure to hotter days, short and intense rainfall, and longer dry periods affects farmers' livelihood and income. In addition, changes in seasonal calendar were also documented at both settlements. Barotu farmers also perceived changes in weather as a result of climate change. Although this was explicitly discussed in Barotu, Toko farmers implicitly used the term 'climate change' and instead used terms such as "*not normal*" and "*not witnessed in the past.*"

4.3.2 Exposure to floods

One factor that increases a community's exposure to floods are rivers or creeks located nearby which can rise with concentrated and heavy rainfall leading to flash flooding (Pacific Food Security Cluster 2016). Nailawa creek and Nasivi river runs through the farming areas of Barotu and Toko respectively, making both settlements exposed to flash flooding. To avoid risk of flash flooding, farmer's houses are located at a safe distance from the river. In both settlements, the creek and the river have never dried up and serves as a source of water for manual irrigation (hand-watering plants) for cash crop fields. Toko Farmer 9 mentioned, "*I have 4 acres of land near the river which is used for cash crops. The good thing about having your farm next to the river is that you can water the farm*."

The majority of farmers agreed that the proximity of the river, heavy rainfall, and flash flooding acts as a form of 'double exposure' in both settlements because it increases "*risk of flooding*" (Barotu Farmer 5). Toko Farmer 18 explained, "*All my farm of 20 hectares is located near the river [.....] Almost 15 hectares are at the risk of flood during heavy rain*." Farmers further raised concerns that "*the flood washes everything away*" and farmers "*lose all [their] crops and income*" (Barotu Farmers 2 and 4). In Barotu settlement, floodwaters can reach the main road and block transportation. Barotu Farmer 20 stressed, "*The river close by causes flood and the floodwater is able to reach the main road - that is how high the river can come*."

While the interviews were being conducted in Barotu settlement, it had been raining for a few days. Barotu Farmer 8 took the opportunity and raised his concerns, "*If the rain continues like this for a few more days, I will lose all my beans which will cost me around $1000.00.*" Even though farmers from both settlements are aware of flood exposure and risks, farmers continue to plant cash crops in flood risk zones. There are several reasons for this. Due to lack of an irrigation system, cash crop farms are located near the river which provides a source of water. Farmers also need to continue cash crop farming to supplement household income (as discussed in Section 4.2.1). Yet, at the same time, heavy rainfall and flash flooding reduces household income. Nonetheless, the recognition of flood risks has enabled farmers to relocate smaller vegetable plots next to their houses to minimise food security risks (as discussed in Chapter 5).

In Barotu settlement, farmers highlighted that exposure to flash flooding could be avoided through proper drainage. Through the use of social memory and past experiences, Barotu farmers have "*have come together few times*" and taken a proactive and collective decision to implement "*proper drainage to minimise the flood risks*" (Barotu Farmers 18 and 20). The collective decision to request proper drainage of the river indicates that farmers are taking proactive measures to reduce exposure to flooding, protect their livelihood, and ensure income and food security. While at the local level, farmers were able to reorganise and make a collective decision, however, the plan for the drainage system was not successfully executed because farmers did not "*receive any assistance from the government*" (Barotu Farmers 18). Barotu Farmer 19 expressed his frustration:

> We have paid money in the [agriculture office] for proper drainage but we are still waiting for them to come. It has been almost nine months. Farmers have paid money for proper drainage in the farms due to the flooding but they still have not come to assist us.

The proximity of rivers in both field sites exposes the settlements to flash flooding. Since the majority of the cash crop fields are located near the river, farmers reported that flash flooding washed away their crops. As a result, farmers have experienced a loss in yield and income. In Barotu settlement, farmers collectively decided that the fields require proper drainage to avoid floods. However, no action has been undertaken by the local authorities to reduce exposure and risk of flooding.

4.3.3 Changes in intensity and frequency of cyclones

Due to climate change, Fiji like the rest of the Pacific, is experiencing an increased intensity of extreme climate events such as floods, storm surges, and cyclones (Chandra & Gaganis 2016; Neef et al. 2018; The World Bank 2018). The cyclone season in Fiji is from November to April with extreme rainfall events likely to increase during this season (Brown, Daigneault & Gawith 2017). Over the last four decades, half of the disasters experienced by Fiji were tropical cyclones (TC). Some examples of major cyclones that impacted Fiji severely include TC Bebe (1972), TC Ami (category 3, 2003), TC Thomas (category 4, 2010) (McNamara & Prasad 2014), TC Evan (category 4, 2012), TC Winston (category 5, 2016) (Esler 2016; Government of Fiji 2012).

According to CSIRO (2011), future climate projections suggest that tropical cyclones in Fiji are projected to become more intense. Participants from both field sites agreed that they were experiencing "*a lot of changes in the recent cyclones*" (Toko Farmer 19). Commonly perceived changes included "*much stronger*", "*more destructive*", and "*more frequent*" cyclones as compared to the past (Barotu Farmers 3 and 18, and Toko Farmer 1). Farmers reported that recent cyclones "*came suddenly with very severe strong wind*" and "*heavier rainfall*" that "*can damage big houses and uproot trees*" (Barotu Farmer 18, 17, and 1). Farmers described changes in cyclones:

> Yes, I have noticed a lot of changes in the cyclone. Nowadays, we get very huge and destructive cyclones. Before, I could clearly remember that the cyclones were not this massive. Today, we are getting cyclones that are in category five. This was not the case before (Toko Farmer 7).

> Yes, there are a lot of changes in the cyclones. The cyclones get stronger and destroy all our crops. Previously, the cyclones were smaller compared to now. The cyclones now are much stronger and much more destructive (Barotu Farmer 15).

Interestingly, one farmer from Toko expressed that destructive cyclones are once in a 15-year event, otherwise, the cyclones are relatively smaller (Toko Farmer 18).

Despite future climate projections suggesting that future tropical cyclones will be less frequent (CSIRO 2011), the majority of farmers claimed that "*these strong cyclones have become frequent*" (Barotu Farmer 12). Toko Farmer 15 explained:

> Nowadays, we face two-three cyclones in one year. We had two cyclones this year. One cyclone did have a small impact and I have heard that we will expect more cyclones this season.

Toko Farmer 10 reflected:

> I have been a farmer for 20 years and in my opinion, the cyclones have become frequent and stronger. I remember before, the cyclones were not so strong and not so frequent.

The section of the research suggests that the majority of farmers from both study sites reported observing major changes in the cyclone intensity and frequency. The findings suggest that both settlements are exposed to stronger, more destructive, and more frequent cyclones as compared to the past.

4.3.4 Changes in intensity and frequency of droughts

The majority of agriculture in Fiji, including sugarcane farming, is rain-fed. As a result, farming systems are highly exposed and sensitive to drought. While rainfall and drought prediction for Fiji is still quite ambiguous (The World Bank 2018), farmers perceived increased incidences of drought across the two field sites. Due to the geographical location and the influence of the south-east trade winds (Feresi et al. 2000), Barotu settlement generally receives more rainfall as compared to Toko, Tavua. Farmers from Barotu settlement mentioned experiencing "*short-term drought*" that "*lasts for around 2-3 months*" (Barotu Farmers 20 and 19). Other farmers recalled their experience with longer "*drought of eight months*" which have "*started to get severe*" (Barotu Farmers 12 and 1). Additionally, one farmer mentioned that the occurrence of drought in Barotu is not as often and severe as compared with "*other areas such as Tavua, Ba, and Yaqara that face severe drought and the cattle do not have any feed*" (Barotu Farmer 6).

Unlike the short-term drought in Barotu, Toko settlement in Tavua is located in a much drier region. Farmers from Toko settlement reported experiencing "*longer and severe droughts*" as compared to the past when "*the drought used to last for only a few months*" (Toko Farmers 5 and 10). Farmers reported that severe droughts have become "*more regular with no rain for three months or a longer period*" (Toko Farmer 9). Many farmers described the slow-onset nature of drought stating that "*slowly, the drought creeps in*" (Toko Farmer 17). Farmers emphasised that the creeping nature of drought makes it harder to predict a drought "*and before you know it, we are in the middle of the drought*" (Toko Farmer 15). As farmers find it

hard to predict a drought, the impacts can accumulate over a period of time and generate severe losses before adaptation measures can be implemented. Considering this, Toko Farmer 17 emphasised, "*This is when we are faced with challenges in the farm.*"

Farmers from both settlements also revealed that they have not planned for long-term drought. Barotu Farmer 19 quoted at length:

> I have not thought or prepared for long-term drought. If we are faced with long-term drought, I do not know what to do. I think farmers need more information on this. We need to plan and prepare for this. The government can help with this. A lot of planning will be needed.

The data reveals that geographical location and rain-fed agriculture in both settlements are major factors contributing to drought exposure and sensitivity. Barotu settlement receives more rainfall in comparison to Toko settlement and is exposed to short-term drought. On the other hand, Toko settlement is located in a much drier region and experiences prolonged and severe droughts. The results also indicate that both settlements are experiencing longer droughts as compared to the past.

4.4 Sensitivity

Sensitivity refers to the organisation or structure of a system that determines the degree to which the system is affected by or responsive to an exposure (Pearce et al. 2018). In Fiji, the sugarcane production system is rain-fed, indicating a particularly high dependency on reliable climatic conditions (Riddell 1990). Since both settlements lack a formal irrigation system, this increases sensitivity to changes in rainfall patterns and other climatic stressors. The majority of farmers reported that they "*cannot afford irrigation*" as such infrastructure is "*too expensive*" (Barotu Farmers 1 and 18, and Toko Farmer 7). Due to lack of a formal irrigation system and inadequate rainfall, farmers from both field sites resort to temporarily using river water manually on their crops. While the river in both settlements provides a form of security during the dry period, it also increases exposure and sensitivity to flooding during heavy rainfall and cyclones (as discussed in Section 4.3.2).

Furthermore, farmers in Barotu settlement are faced with limited water supply. As a result, reduced availability of water increases sensitivity to drought. Barotu Farmer 12 mentioned, "*Water supply is limited. We have a lot of houses here and very limited water supply*." Raising his concern, Barotu Farmer 5 added, "*We face a lot of hardships with water and during drought, this gets worse*." Due to the limited water supply in Barotu, farmers have invested in infrastructures such as boreholes, wells, and water tanks (as discussed in Chapter 5). However, farmers with water tanks faced difficulty in refilling their water tanks on time and "*had to call [the relevant authorities] to get our water tanks filled*" (Barotu Farmer 15). Barotu Farmer 10 explained:

> When the water runs low [in the water tank], we have to call to get water refilled. At times, there is no water. So, I need help with this. Otherwise, we have to borrow water from somewhere.

In contrast to Barotu settlement, Toko settlement has a regular water supply. Toko Farmer 12 commented, "*There is a regular supply of these unless there is a cyclone or flood*." Similarly,

Toko Farmer 14 said, "*Yes, we have a proper supply of water. We only face problems during the cyclone otherwise there is proper supply*."

The research findings reveal that since sugarcane production and cash crop system are rain-fed, any changes in rainfall patterns would increase sensitivity to droughts. Hence, during dry periods, farmers resort to the river to manually water their crops. The interviews revealed that although Barotu farmers experience short-term droughts, the settlement is faced with limited water supply and finds it difficult to get their water tanks refilled on time face. This increases farmers' sensitivity and vulnerability to drought. On the other hand, Toko settlement is exposed to prolonged and more severe droughts but has a regular supply of water.

4.5 Impact of cyclones

Farmers from Barotu and Toko settlements noted severe impacts from recent cyclones. Respondents mentioned that recent severe cyclones "*brought devastation on sugarcane farms and cash crops farms*" (Barotu Farmer 1). Owing to TC Winston's nature and severity, many participants reflected on the substantial impacts brought about by TC Winston in 2016. Since both settlements were located in TC Winston's path, the settlements were exposed to destructive hurricane-force winds and torrential rainfall (Esler 2016).

Recalling her experience with TC Winston, Toko Farmer 20 stated, "*The cyclone damaged my sugarcane and cash crops. The impacts were very severe. Everything in the cyclone's path was destroyed*." Barotu Farmer 20 also raised similar concerns, "*The cyclone affected us badly. The impacts were evident on our farm. Our livelihood and income were very badly affected by the cyclone*." The impact on farmers' livelihood and income is concerning because it deepens poverty and threatens the sustainability of livelihood (Esler 2016). Such devastating impacts in SES could materialise in compounding and cascading impacts emphasising the interconnected nature of SES components (discussed further in Chapters 5, 6, and 8).

Additionally, respondents from both field sites identified intense winds accompanying TC Winston. Participants described the winds as "*very intense*" and "*very strong and dangerous*" (Barotu Farmers 1 and 12). Due to the strong winds, "*concrete buildings were damaged and big trees were uprooted*" (Barotu Farmer 18). The strong winds not only damaged houses but also "*damaged power lines*" (Barotu Farmer 5). Toko Farmer 6 mentioned, "*I remember the power line next to my house fell during Winston*." Due to the damages to the power line during TC Winston, "*there was no electricity have electricity for almost 6 months*." Farmer also mentioned "*loose debris flying around*" (Barotu Farmer 8). With debris flying around, a lot of waste accumulates on farmers' properties. Toko Farmer 16 said, "*There is a lot of debris and big branches. There is also a lot of household waste and things like diapers and roofing iron in our farm*."

Participants further identified torrential rainfall accompanying the cyclones. The heavy rainfall exposed both settlements to flash flooding during the cyclone. Brown, Daigneault & Gawith (2017) indicated that flooding in Fiji is enormously costly and annual losses from flooding are projected to increase even with moderate climate change, and similar information was provided by respondents. Barotu Farmer 9 noted, "*The rain was so intense that within minutes there was flooding*." Many participants also stated that "*due to flash flooding, the roads are closed off which blocks access to main roads*" (Barotu Farmer 4). Barotu farmer 1

also expressed his fear of flash flooding. "*There is a lot of heavy rainfall, and we get flash flooding, there is nowhere to run*" (Barotu Farmer 1). Similar experiences have been noted in Toko settlement. Toko Farmer 14 mentioned, "*The heavy rain causes the road to be swept away and there was flood*" (Toko Farmer 14).

Moreover, the data revealed that impacts of cyclones are not only evident on social systems but also on ecological systems. For example, respondents noted washing away of farms, soil erosion near the riverbank, and spreading of invasive plants. Barotu Farmer 13 stated, "*We had heavy rainfall and flooding. The river washed away many farms and the nearby land*." Barotu Farmer 5 also made the same observation, "*There is very intense rain and there is a flood. In some places, the land near the river is washed away*." One farmer also mentioned that the flood "*brings in invasive plants from nearby*" (Toko Farmer 9).

The findings indicate devastating cyclone impacts in both Barotu and Toko settlements. Severe impacts were noted on both social and ecological systems. Strong winds accompanying cyclones damaged concrete buildings and houses, power lines, and trees are uprooted. Heavy rainfall caused flash flooding which washes away roads and farm topsoils, introduces invasive plants, and causes soil erosion.

4.6 Impact of drought

The impacts of recent severe droughts were evident in both Barotu and Toko settlements. During recent severe droughts, Barotu farmers observed "*dryness of soil with cracks*" (Barotu Farmer 20). Barotu Farmer 1 said, "*The soil will look moist on the top but will be very dry. The moisture provided to the top layer soil will be quickly taken in by the topsoil leaving other layers dry*." Due to lack of soil moisture, farmers highlighted that "*we are unable to plant anything*" and as a result "*we lost majority of our sugarcane and cash crops*" (Barotu Farmers 19 and 3). Furthermore, farmers from Barotu settlement were thankful that during the drought, there was availability of grass for the cows to feed on. Barotu Farmer 14 said:

> We are lucky that during drought we have feed for the cattle. However, if you pass Rakiraki then the situation gets worse. Those areas are very dry, and they do not have any feed for the cattle.

Additionally, since Barotu settlement has limited water supply, farmers noted devastating impacts on households as well. Barotu Farmer 10 quoted at length:

> During drought, we are faced with a lot of water issues. The farm is affected by lack of water as well as the household. I have to look for water for the household. If my water tank does not get refilled on time, it gets difficult to do housework like cooking, washing clothes, and cleaning the dishes.

On the other hand, farmers from Toko settlement reported prolonged droughts with severe droughts impacts. Toko farmers reported that the "*soil becomes very dry, cracked, and very hard*" (Toko Farmer 1). Severe impacts were also noted in sugarcane farms. Toko Farmer 12 said, "*During the drought, the sugarcane looks burnt.*" Toko Farmer 7 highlighted, "*We have put a lot of hard work and effort in the sugarcane field for almost six months and then the drought hits and everything dries up*."

Moreover, farmers in Toko settlement noted that prolonged drought stress affects biological processes in plants. Toko farmer 19 explained, "*During the drought, sometimes the plant does not germinate and if they do, then they do not flower or the flower drops*." Additionally, farmers from Toko settlement reported less feed for their livestock in the grazing areas due to prolonged drought. Toko Farmer 12 added, "*There is also no feed for the livestock, so we have to look for the feed*." Toko Farmer 18 further explained:

> We normally have to look for the feed near the river and tie the cows there. If you have a tractor, then you can cut and carry the feed home. If you don't, then you cut the feed and put it in a sack and carry it home.

Due to reduction in sugarcane and cash crop yield, farmers from both settlements report reduced household income. Barotu Farmer 15 explained, "*During the drought, we lose all our crops. This has an impact on our income and the household*." Toko Farmer 17 also added, "*It is a difficult time when we are faced with drought. We have less income in the house*." In addition, the lack of cash crop yield has a cascading impact on food security and the prices of vegetables. Since farmers depend on cash crops for household food consumption, during drought, reduction of cash crop yield increases food insecurity risks. Also, available cash crops are sold at a higher market value. Barotu Farmer 14 said, "*At times, we have to buy vegetables from the market, and I have noticed that the prices of everything go up*." Farmers from Toko settlement also faced similar challenges. Toko Farmer 13 stated, "*If we do not have fresh vegetables, then we have to go to the town and buy food. The prices of vegetables during the drought are very expensive. It is better to buy tin food.*"

Farmers from both settlements also expressed concern that there are increased incidences of pest outbreaks during the drought. Barotu Farmer 20 said, "*Yes, when we have severe drought, we have a lot of pests*." Similar pest outbreaks are noted in Toko settlement. Toko Farmer 17 said, "*There are also new pests which are hard to get rid of*." Toko Farmer 13 highlighted, "*Yes, I have noticed that the pests these days are difficult to kill with pesticides. We did not have these kinds of pests before. These are new pests that I am seeing*." As a result, farmers from both settlements have intensified the use of agrochemicals as a response to pest outbreaks without necessarily accounting for the consequences to human health and soil and river productivity. Barotu Farmer 20 said, "*The plants cannot survive without the use of pesticides. We use pesticides very frequently in this case. Otherwise, our crops will be damaged by the pests*."

The results indicate that both settlements suffer severe drought impacts. However, since Toko settlement is exposed to longer-term severe drought, drought impacts in Toko settlement were more profound. Similar drought impacts from both settlements included dryness of soil, decline in cash crop and sugarcane yields, and increased incidence of pest outbreaks. More severe drought impacts in Toko settlement included burnt-like appearance of crops, lack of germination, lack of flowering in cash crops, and less livestock feed. These impacts also reduced household income and increased food insecurity risks in both settlements.

4.7 Adaptive capacity

The IPCC (2012) defined adaptive capacity as the combination of strength, attributes, and resources available to prepare for and undertake actions to reduce adverse impacts, moderate harm, and exploit beneficial opportunities. Other factors that determine adaptive capacity in

the context of Pacific Island communities include traditional knowledge, social learning, and history of dealing with climate stress are been increasingly emphasised in recent literature (Dumaru 2010; Warrick et al. 2017). According to Smit & Wandel (2006), a range of social, economic, cultural and political factors shape adaptive capacity. Building on Smit & Wandel (2006), this research emphasises that social, economic, cultural, and political factors are also integral components of social and ecological foundations which largely determine social and ecological well-being and long-term sustainability of SES. This section of the research documents how adaptive capacity is influenced by local household capacity (access to livelihood assets, traditional knowledge) and institutional capacity (early warning, access to information on cyclones and droughts, and climate change). As discussed below, the findings reveal that adaptive capacity varied among households in both settlements'

4.7.1 Access to livelihood assets

Livelihood assets, as defined by Currenti et al. (2019), are key determinants of household adaptability and include tangible and intangible assets. Currenti et al. (2019) and Shabina et al. (2021) recognised the importance of livelihood assets for experiencing and responding to social and ecological changes, maintaining social and ecological well-being, and long-term sustainability. This research argues that livelihood assets are an integral component of the social and ecological foundations as it determines household adaptive capacity under recent social and ecological changes. This section documents adaptive capacity in Barotu and Toko settlements through access to physical, financial, natural, and social capital.

During the interview, farmers were asked to share what farming assets they owned. The majority of farmers from both settlements mentioned having basic farming tools such as forks, spades, seeds, fertilisers, cane knives, buckets, boreholes, and water wells. Barotu Farmer 12 mentioned, "*I have some livestock. We also have drums and buckets for collecting water and watering our plants. I have seeds, fertiliser, and farming tools like a cane knife. I also have a safe place to put seeds and manure*."

Very few farmers mentioned having access to physical assets such as tractors, water pumps, and trucks as they are too expensive to purchase and maintain. Storage capacity in relation to seed storage space and water storage (water tank) was also mentioned by very few farmers.

> We have a tractor. I have some livestock like ducks, chickens, and goats. We also have a borehole and a water pump. We also use drums for storage of water that we use in the field. I have seeds, fertiliser, farming tools like cane knife, fork, and a spade. My seeds are stored in a separate room. I also have a truck that I use on my farm. We also have a bigger truck and a personal car (Barotu Farmer 18).

> I have a tractor and I have a few livestock. I also have a well and water tank to use during drought. I own some cane knives, forks, and spades. I own seeds, fertiliser, and pesticides which I store in a secure place (Toko Farmer 14).

As mentioned earlier, both settlements do not have formal irrigation systems as these are expensive infrastructures. In addition, many poor households from both settlements mentioned not having access to essential physical assets such as a water pump which households could use intermittently during the drought (Barotu Farmer 16). The lack of access to water pumps prevents farmers from sustaining agricultural production and

undertaking adaptation measures which increases farmers' vulnerability and losses to droughts (as discussed in Chapter 5). Other physical assets noted in both settlements included boreholes, water wells, and water tanks which are utilised as short-term adaptation measures during drought (discussed in Chapter 5). Barotu Farmer 18 said, "*Yes, I have a borehole for water supply*." Another farmer mentioned using her water well during dry period. "*At times, we have no water especially during the dry season. I have a well which I use during the dry season*" (Barotu Farmer 10).

The interviews from both field sites documented lack of financial capital. The data has revealed several reasons for lack of financial capital. Firstly, farmers are highly reliant on climate-sensitive livelihoods. A slight variation in weather and exposure to bio-physical events would affect crop growth and yield, affecting farmers' income. The constant devastating impacts of cyclones and droughts further place farmers in financial hardship. Lack of financial capital also restricts farmers from implementing appropriate adaptation measures (as discussed in Chapter 5). Barotu Farmer 1 mentioned, "*Cyclones and droughts are getting more severe. How will poor farmers like us cope? We do not have the finance. We need assistance*." Toko Farmer 7 said, "*Yes, we face a lot of hardship especially since our children are small and not working. We need financial support*."

Farmers also have access to land as an asset. However, Barotu farmers face land tenure insecurity which adversely affects their adaptability to cyclones and droughts (as discussed in 4.2.2).

Finally, few farmers from both settlements mentioned relying on familial social networks to enhance adaptive capacity. Farmers utilise social networks in form of social capital to leverage support during cyclones and droughts (also discussed in Chapter 5). For example, the provision of financial support through social networks enables managing of risks and sharing of burdens during times of crisis. Barotu Farmer 20 mentioned, "*I rely on my son for household expenses as he is employed outside*." The data reveals that social capital, cohesion, and networks and connectedness are crucial for building adaptive capacity and is a critical element of resilience for rural livelihoods.

Access to livelihood assets such as physical, financial, natural assets, and social capital acts as a determinant of adaptive capacity which is context-specific and depends on individual households. Farmers from both settlements indicated lack of financial capital while preparing for the adverse events. Overall, the findings suggest that accessibility to livelihood assets such as physical, financial, natural capital, and social capital influences adaptive capacity of farmers which either facilitates or constraints adaptation measures and determines long-term sustainability.

4.7.2 Traditional knowledge

Local traditional knowledge is a crucial aspect of social and ecological foundations as local knowledge and experiences have been accumulated over many generations as an effective strategy to prepare and respond to social and ecological changes. McNamara & Prasad (2014), in their research on coping with cyclones and droughts in Fiji and Vanuatu, highlighted that traditional knowledge plays a crucial role in enhancing adaptive capacity and planning community-based adaptation measures.

In Barotu and Toko settlements, the majority of inhabitants have resided in these areas for more than five decades and have developed strong knowledge in relation to their local environment. Participants from both settlements reported that their traditional knowledge has been accumulated through their parents, personal experiences, and personal observations. According to Barotu Farmer 19, "*My parents have lived here in this settlement. So, whatever knowledge I have has been passed down to me from my parents and through my personal experiences and observations*." Toko Farmer 20 explained, "*I have been in this settlement for more than sixty years. My husband was here before me and before him his parents. So, this knowledge has been gathered for many, many years*."

Accumulation of local traditional knowledge and its oral transfer down many generations supports strategies to prepare and respond to social and ecological changes. For instance, farmers noted that hotter than usual weather during the cyclone season is an indication that a severe cyclone will come. The use of traditional knowledge creates awareness and provides opportunities to prepare for cyclones. As explained by Barotu Farmer 5, "*At times, we can forecast a cyclone due to changes in weather. When it is hotter than usual it is a sign that a cyclone will come*." Toko Farmer 16 explained, "*If during November to April it is very, very hot - hotter than usual, then we know we will get a severe cyclone and we have to be prepared*." While traditional knowledge may provide awareness and opportunities for climate adaptation, lack of livelihood assets (as discussed in Section 4.7.1) and lack of institutional support (as discussed in Sections 4.7.3 and 4.7.4) could act as a barrier for implementation of adaptation options resulting in severe impacts and L&D.

Moreover, given that drought is a localised and a slow-onset event, farmers from both settlements relied on their personal observation and traditional knowledge to become aware that a drought was approaching. Observing the weather patterns, such as lack of rain, the dryness of the soil, and the appearance of cracks in the soil was an indication that the drought was approaching. As mentioned by Barotu Farmer 8, "*We can tell that the drought is near when there has been no rainfall and the soil appear dry*." Toko Farmer 15 stated:

> As farmers, we can tell from the weather. If there is no rain for some time, then we know that a drought is coming. Plus, the soil also gets dry, and we can see cracks in the soil. This is an indication that the drought will be long. The grass also doesn't grow. If it rains, we cut the grass 3-4 times. But, during the dry weather, the grass does not grow.

Toko Farmer 18, using his traditional knowledge, revealed:

> The droughts here are slow-onset. In February and March, we expect rainfall. Then the rainfall will decrease in April. Then in May, June, and July is the cold season. Then from July onwards, we get drought. It creeps in slowly and the drought stays with us until December.

The results suggest that local traditional knowledge is an essential aspect of social and ecological foundations as local experiences and knowledge have been accumulated over many generations as an effective strategy to prepare and respond to social and ecological changes. The use of local observations and traditional knowledge creates awareness, enhances adaptive capacity, and preparedness for cyclones and droughts in Barotu and Toko settlements which

also determines social and ecological well-being. Farmers indicated that hotter than normal condition is an indication of severe cyclones. Hence, farmers become aware and prepared for a cyclone. On the other hand, observing weather patterns such as lack of rain and the dryness of the soil is an indication that a drought is approaching.

4.7.3 Receiving early warnings on cyclones and droughts

In Fiji, early warning on cyclones and droughts, tropical cyclone outlook, and other relevant information is provided by the Fiji Meteorological Services. Cyclone warnings and outlooks provided by the Fiji Meteorological Services are then shared by relevant media outlets, including sharing information on social media. During disasters, access to social media platforms is important as it provides an opportunity to increase information outreach (Otto, Mehta & Liu 2018). However, in the Pacific, infrastructure is limited and as a result, risk communication becomes very challenging (Handmer & Iveson 2017).

In Barotu settlement, it was noted that there was very limited internet coverage which restricts access to social media and the Fiji Meteorological Services website. Barotu settlement also has very poor mobile phone connectivity due to the damages sustained to the telecommunication tower during TC Winston in 2016. To date, the infrastructure has not been repaired. As a result, the use of social media and mobile phones to share and access information about cyclones remains limited and hinders disaster awareness and preparedness. Barotu Farmer 11 expressed:

> We do not have an internet connection here and because of this, we do not have a smartphone to keep updated with the weather forecasts. After TC Winston, the internet connection is no more.

Regarding cyclone alert, one farmer in Barotu settlement mentioned that farmers "*do not rely on the phone. After the cyclone has passed, then we receive messages on the phone*" (Barotu Farmer 19). The lack of access to cyclone alerts is a growing concern for Barotu settlement as it constrains farmers' adaptive capacity. Additionally, the failure to repair and invest in the telecommunication tower after TC Winston should be recognised as a prioritisation failure of the Fijian government.

Due to unreliable phone message alerts and lack of access to social media, Barotu farmers preferred media for cyclone updates is the radio. According to Barotu Farmer 1:

> The only way we become aware that a cyclone is approaching us is through the radio. We do not rely on the TV for this. However, since we recently got Wailesi, another TV network, I am hopeful that such news will be shared.

Once the necessary cyclone alert has been received, farmers undertake necessary cyclone adaptation measures (as discussed in Chapter 5). Barotu Farmer 16 mentioned, "*The radio informs us what we should and should not do before a cyclone, and what precautionary measures to take*."

On the other hand, farmers from Toko settlement had good coverage for radio, television, social media, and mobile phones for cyclone warnings. Regardless, similar to Barotu settlement, the majority of farmers mentioned radio as their preferred source of information for "*staying alert*" (Toko Farmer 18). Toko Farmer 1 mentioned, "*We normally stay alert*

through the radio and hear news of a cyclone approaching." While social media plays a crucial role in disaster communication (Finau et al. 2018), the findings demonstrate that farmers from Barotu and Toko settlements consider radio as a responsible media outlet for risk information dissemination. This finding is similar to the research conducted by Magee et al. (2016) on tropical cyclone perception from Fiji, Vanuatu, and Tonga. The study highlighted that receiving updates through the radio is the most cost-effective and also a necessity in receiving tropical cyclone alerts (Magee et al. 2016).

There was also consensus among farmers in both settlements that strong community networks, that is, strong community cohesion play an important role in cyclone updates. As stated by Barotu Farmer 17, "*At times, if we fail to hear the radio news, since the community bond is strong, we are informed through the community members.*" Toko Farmer 11 said, "*I normally stay updated through the radio or when I am in the field, I hear cyclone updates from other farmers*."

In natural resource-based communities, where access to information for disaster preparedness is limited, one would expect local stakeholders to proactively inform farmers of the cyclone approaching. However, farmers from both field sites gravely pointed out:

> No, we do not have information sessions on cyclones or disasters here. We have not had this kind of session in our area. I think TC Winston has set an example and government officials should conduct this type of information session so that farmers are better prepared (Barotu Farmer 18).

Farmers from Toko settlement also expressed their frustration by saying that the agricultural officers offered no information and assistance before the cyclone. Toko Farmer 16 stated:

> No, the agricultural officers have never provided any form of advice. The agricultural officers have not come here to date. They never come here.

On the other hand, farmers became aware of drought through their personal observation and traditional knowledge (as discussed in Section 4.7.2). Given recent exposure to severe drought risks, farmers from both settlements acknowledged that agricultural officers should offer assistance and advice during droughts (Barotu Farmer 1). Yet, farmers from both settlements raised concern that "*agricultural officers do not come to inform us about drought approaching*" (Toko Farmer 19). Providing clarification on lack of outreach and awareness for farmers, one agricultural officer mentioned that there is another ministry for conducting awareness on cyclones and droughts. Agricultural Officer 1 explained:

> Yes, this is the National Disaster Management Office that is responsible for creating awareness. The NDMO has been allocated the cyclone awareness budget. The NDMO is responsible for going into the district and creating awareness [....] Yes, the Head of [Agriculture] Department does talk to his ground officers after the awareness session. But it is not effective since we do not have the budget for disaster awareness [....] The Ministry that is responsible for creating such awareness will have the necessary budget and the programme to carry out such awareness.

Furthermore, access to an early warning system is crucial to ensure enhanced adaptive capacity. However, an absence of a drought early warning system has been documented in the Ministry of Sugar Industry (as discussed in Chapter 6). Due to the lack of a drought early warning system, there is limited drought risk identification (Stakeholder 9). The lack of drought detection and lack of early warning further restricts adaptive capacity of rural agricultural communities making them more vulnerable to drought risks.

The results indicate that Barotu settlement has limited access to cyclone alerts and poor mobile connectivity. The lack of access to cyclone early warning in Barotu undermines access to reliable information and constraints farmers' adaptive capacity. Due to limited internet access, farmers from Barotu settlement rely on radio and community networks for cyclone alerts. On the other hand, Toko settlement has access to radio, television, and internet connectivity for receiving cyclone alerts. Similar to Barotu settlement, Toko settlement farmers' preferred source of information is the radio and community networks. Furthermore, farmers use their personal observation and traditional knowledge for drought awareness.

4.7.4 Access to climate change information

Access to climate information is necessary for supporting farmers' livelihood, encouraging effective risk management, implementation of adaptive measures, and building resilience of communities (Falco & Sharma-Khushal 2019; van Huysen, Hansen & Tall 2018). As mentioned earlier, both sugarcane communities are exposed to cyclone and drought risks and have climate-sensitive livelihoods. Regardless, data from both settlements has revealed that there have been no climate change awareness sessions. According to Barotu Farmer 12, "*No, the agricultural officers do not come to us with information on climate change. They have no information session*."

While at the international level, the government of Fiji has been leading the fight against climate change and has been called a Climate Champion, at the local level, institutional support to assist farmers needs to be strengthened. For example, farmers highlighted lack of government leadership and lack of support for climate change awareness. Barotu Farmer 1 expressed his frustration:

> Neither the government nor the agricultural officers have not consulted us or prepared us for climate change. The government thinks that a farmer can manage on its own. We were also promised a lot of assistance during this election but after the election, we have been forgotten. They have made a false promise.

Barotu Farmer 4 raised concerns:

> I am very upset with the agricultural officers. They are not well informed on climate change. I have not seen some of the agricultural officers to date. I have tried to visit him in his office but I have not seen him to date. I have found out that he is on sick leave at times or on leave. I am not sure what he does, he seems to be wasting the taxpayer's money. He should resign and leave.

Despite the lack of institutional support and lack of internet access, farmers in Barotu settlement remained interested in climate change issues. Even though farmers from Barotu settlement only had radio access, and more recently a stable television network (as discussed in Section 4.7.3), farmers from Barotu settlement managed to stay updated with climate

change issues. To illustrate this point, farmers were able to make connections that hotter days, variation in rainfall, severe and frequent floods, cyclones, and droughts are a result of climate change (as discussed in Section 4.2). Additionally, Barotu Farmer 19 mentioned, "*Climate change will lead to fight over resources such as water, land and also food in the future*." Barotu Farmer 1 articulated:

> Yes, I stay updated through the radio and I have heard about the [climate change] meetings. I am certain that climate change will happen, and it will get worse. This is only the beginning. I have heard of bushfires in other countries, and this is all because of the heat that is related to climate change. I have heard of the recent Australian bushfire and the lives lost as well as the homes destroyed. I know for certain that the impact of climate is unstoppable even strategies will fail against climate change.

On the other hand, while Toko settlement has access to radio, television network, internet services, social media, and good mobile phone coverage, farmers indicated poor knowledge of climate change. Toko Farmer 15 stated, "*No, I have not come across [climate change]*." Toko Farmer 17 asked, "*No, I have not heard of this before. What is this?*" The implicit reference to climate change was also made by Toko farmers in Section 4.3. Therefore, the findings indicate that apart from media outreach, community outreach is just as important for climate change awareness.

Overall, results indicate that farmers in Barotu settlement relied on radio for climate change awareness and were well informed of climate change issues. Interestingly, one farmer perceived Australian bushfires were a result of climate change and indicated that climate change is unstoppable. On the other hand, the majority of farmers in Toko indicated that they have not heard of the term climate change. One reason for this could be lack of community awareness sessions. The lack of institutional support from the agricultural officers and lack of awareness on climate change could limit adaptive capacity of farmers.

4.8 Conclusion

As a starting point of analysis, this research utilised the vulnerability approach outlined by Pearce et al. (2018) to document vulnerability in Barotu and Toko settlements. The same vulnerability approach has introduced by the IPCC (2007, 2014). The key findings suggest that SES vulnerability at the local level is context-specific and influenced by social and ecological foundations, exposure to bio-physical events, sensitivity, and adaptive capacity.

The study indicates a high level of vulnerability to cyclones and droughts in both settlements. Both field sites were exposed to severe cyclones while exposure to drought varied between both study sites. High sensitivity to cyclones and droughts were noted across the two study sites. Adaptive capacity varied among households and overall poor adaptive capacity was noted in both settlements due to lack of physical and financial assets, insecure land tenure, lack of stakeholder involvement, poor early warning system, and lack of access to climate change information. Therefore, the findings reveal that vulnerability to climate change is also influenced by non-climatic factors, such as the social, historical, and livelihood context of the households.

The research findings show that both settlements are highly exposed to cyclones and suffer

severe cyclone impacts. For example, farmers from both study sites noted more severe, more destructive, and more frequent cyclones. High exposure, high sensitivity, and low adaptive capacity resulted in devastating cyclone impacts in both settlements.

Furthermore, vulnerability to drought varied across both field sites. The results indicate that Toko settlement is more vulnerable to drought. This is because Toko settlement was exposed to long-term and severe droughts. Therefore, high exposure, high sensitivity, and poor adaptive capacity resulted in severe droughts impacts in Toko settlement such as brunt-like appearance of crops, lack of germination and lack of flowering of crops, and lack of livestock feed.

Additionally, the research strongly suggests that elements of vulnerability are interconnected and interact with each other to produce complex relationships. For example, the findings from this research indicate that social and ecological foundations not only have an influence on exposure and sensitivity but also determine adaptive capacity and SES impacts. The research highlights that social and ecological foundations is a key component of vulnerability and should be explicitly considered and discussed in vulnerability analysis at the local level. In addition, this research argues that enhancing the state of social and ecological foundations should enhance social and ecological well-being which is key for resilience. The following chapter will discuss what adaptation measures are undertaken to avert and minimise L&D and the residual L&D.

Chapter 5 Evidence of anthropogenic climate change loss and damage due to cyclones and droughts: A case study of Barotu and Toko Settlements

5.1 Introduction

The primary objective of this chapter is to document anthropogenic climate change loss and damage (L&D) in Barotu and Toko settlements due to cyclones and droughts. Major themes from farmer interviews are presented in this chapter. This research uses the L&D framework developed by van der Geest & Warner (2015) (discussed in Section 2.4) to document adaptation measures and L&D in the two Indo-Fijian sugarcane communities. Using this framework, this chapter examines the relationship between autonomous community-based adaptation measures and the resulting L&D. To further differentiate between distinct levels of adaptation, this chapter adheres to the adaptation framework provided by Rickards & Howden (2012) as discussed in Section 2.3.6.

This chapter will use the above frameworks to document adaptation measures for cyclones and droughts in Barotu and Toko settlement in Sections 5.2 and 5.4. Sections 5.3 and 5.5 documents L&D from cyclones and droughts respectively. In addition, this chapter categorises L&D into avoided, unavoided, and unavoidable L&D as proposed by Verheyen & Roderick (2008) (as discussed in Section 2.4). Section 5.6 presents the concluding remarks for this chapter. In doing so, this chapter addresses research objective two which is to identify current community-based coping and adaptation strategies for sugarcane communities in Fiji and residual L&D.

5.2 Adapting to cyclones

This section of the results documents how farmers from Barotu and Toko settlements adapt to cyclones. Where similar trends of adaptation or similar themes are noted in both Barotu and Toko settlements, quotes from one field site are presented. As discussed below, adaptation measures in both settlements include farm protection measures, property protection measures, and personal protection measures. These protection measures are further categorised as bearing the effects of cyclones, coping measures such as reactive and short-term behavioural changes, incremental adaptation, and systems adaptation. No transformational adaptation was noted in both communities.

5.2.1 Farm protection measures

Similar farm protection measures for sugarcane and cash crop farms were noted in both field sites. Given the severity of recent cyclones, accompanying strong winds, and heavy rainfall, all farmers from both settlements stated that no adaptation measures were undertaken in the sugarcane farms. Farmers mentioned that "*there is nothing anyone can do in the sugarcane farm*" and waited for "*the strong winds to flatten and break the sugarcane and the flood to sweep everything away*" (Toko Farmer 17 and Barotu Farmer 12). Instead, farmers chose to bear the effects of cyclones and associated L&D on their farms. Barotu Farmer 8 said, "*When the cyclone is approaching, we cannot do anything. We wait for the strong wind to blow everything away. There is nothing else we do can*."

Interestingly, some farmers implemented adaptation measures on their vegetable farms prior to a cyclone. For example, reactive, short-term behavioural changes were common responses from farmers before a cyclone. One of the farmers from Barotu settlement mentioned that he prefers to cut the stem of the okra as close to the ground prior to a cyclone so that the strong

winds do not break the stem. Cutting stems closer to the ground prevents significant farm loss and "*provides a regular source of income for the household*" (Barotu Farmer 20). Barotu Farmer 12 explained, "*If the okra plant is tall then we trim this so that it does not get caught in the wind. Otherwise, the plants will get caught in the wind and get damaged*."

The findings suggest that reactive, short-term behavioural changes such as cutting stems closer to the ground could prevent farm losses. Yet, such reactive and short-term coping mechanisms are only implemented immediately prior to a cyclone event (Magee et al. 2016) and are later abandoned or not considered when the conditions have passed (McCubbin, Smit & Pearce 2015) – indicating an absence of continuous SES adaptation measures. McNamara & Prasad (2014) noted similar coping measures in Fijian villages where cutting stems closer to the ground prior to a cyclone significantly reduced farm loss.

Other coping strategies included picking their cash crop immediately before the cyclone. Mature cash crops were hand-picked for household consumption and the surplus was later sold in the market to earn income. Selling cash crops in the local market also ensured that "*cash crops do not go to waste*" (Toko Farmer 15). Barotu Farmer 18 said, "*If the crop has not matured then we cannot pick this and if it has matured then we can pick this before the cyclone*." Thus, short-term coping measures implemented prior to a cyclone event could assist in avoiding some potential farm losses. However, there are limits to these practices, due to the marketplace being full of other farmers trying to sell their cash crops, hand-picked prior to the cyclone (Barotu Farmer 10).

During the cyclone season, there is also a greater risk of flooding in communities that are located in low-lying areas or near rivers. To avoid cyclonic and associated flood risks, few farmers from Toko settlement implemented incremental adaptation measures by planting less or "*not having any crops in the farm*" (Toko Farmer 15). Although planting less would avoid farm losses, at the same time planting less is an erosive adaptation strategy because "*there is less income in the household*" and could lead to food insecurity (Toko Farmer 16). For that reason, to simultaneously overcome risk of floods and food insecurity, some farmers have relocated and established small vegetable plots next to their house. Such systems adaptation indicates that farmers were proactive in avoiding risks which they recognised were becoming more likely. Supporting this claim, Toko Farmer 5 explained:

> I had decided to move my family garden next to my house due to flooding. It is a small plot and caters for my family. The rest of my sugarcane farm and cash crop is located near the river which is a bit far away.

Women farmers from both field sites pointed out that during the cyclone season they felt overburdened with work. For example, women farmers "*had to look after their household and their family as well as their farms*" (Barotu Farmer 11). Toko Farmer 2 pointed out, "*During this time, I have to work in the farm and my home. I also have to look after my family*." Women farmers who felt overburdened with house and farm commitments reported that "*there is nothing we can do in the farm*" (Barotu Farmer 20). The inability to implement any adaptation measures significantly reduces farm yield as farmers are "*not able to save anything in the farm*" (Toko Farmer 20). On the other hand, women farmers who had assistance prior to a cyclone implemented short-term and reactive adaptation measures such as "*picking matured vegetables with the help of my children*" (Toko Farmer 11).

The results from this research indicate that no specific coping or adaptation measures were undertaken in sugarcane farms. Farmers chose to bear the effects and cope with cyclones. The majority of farmers implemented reactive and short-term measures prior to a cyclone event such as picking matured crops. Some farmers also considered erosive incremental adaptation strategies such as plating less during the cyclone season which undermined household income and food security. Systems adaptation documented included relocating family farm next to the house to avoid floods and cyclones.

5.2.2 Property protection measures

Farmers from both communities undertook similar reactive and short-term measures to protect their properties as cyclones approached. For example, farmers from both settlements secured their house by "*cutting down big trees to prevent damage*", "*putting on shutters*", and "*securing houses with ropes*" (Barotu Farmers 5 and 3, and Toko Farmer 20). Consistent with the findings of this study, research by Gawith, Daigneault & Brown (2016) and McNamara & Prasad (2014) indicated that preparation for disasters in Fijian agricultural communities mostly included taking property protection measures such as securing houses with ropes, putting window shutters, and trimming big trees.

While some farmers were able to implement property protection measures prior to a cyclone, few farmers mentioned that "*there is not enough money to fully secure the house during the cyclone*" (Barotu Farmer 8). Therefore, lack of finance is a barrier to successfully implementing property protection measures in both communities. Additionally, farmers with children also raised concerns regarding lack of finance. Barotu Farmer 14 emphasised:

> Yes, we do face financial constraints. This is because the new school term starts in January. So, we need to save up for that as well. If the cyclone hits us in January, we have to prioritise if we want to secure our household or save money for school expenses.

Again, women farmers faced difficulties in securing their house. Barotu Farmer 10 raised the concern, "*I did not have time to prepare for the cyclone. I need help because I live alone. Sometimes, I ask for help but there is no one to help me*." Unable to implement any property protection measures, most women farmers endured the effects of cyclones on their property. On the other hand, some women farmers relied on community cohesion and social networks to assist in securing their houses. Most of the time, women farmers "*had to call for help*" (Toko Farmer 17). Barotu Farmer 11 expressed:

> When the cyclone is approaching, if there is anyone that can help, then I secure my windows and put on shutters. This is the only constraint that I have faced. There are some people that have asked for money when I have asked for help. But people are mostly kind enough to help.

In addition to securing their houses, farmers from Toko settlement also mentioned securing their farming assets. Toko Farmer 9 commented, "*I collect all my materials such as drums and hose pipes and store them safely. I also try to store my seeds in a properly so that it does not get wet*." Toko Farmer 11 also highlighted, "*I normally tell my children to collect all the farm equipment and bring it home*."

Moreover, during the cyclone, farmers also cared for their livestock. Livestock such as cows and bullocks are regarded as valuable assets in farming communities as they are used to plough fields, provide milk for the family, and are sold to ensure household income during disasters. As traditionally practised, farmers from Barotu and Toko settlements "*moved their livestock away from the river and from the flood*" to "*higher grounds*" to avoid being swept away by the flash flooding (Toko Farmer 15 and Barotu Farmer 16). Toko Farmer 1 emphasised:

> I also take care of my livestock such as cows and move them to higher ground. During the flood, you can actually see dead cows being washed away in the flood river. It is a horrible sight.

Apart from moving livestock to higher ground, few farmers mentioned protecting their livestock from tree fall by "*making sure that they are close to the house and not tied close to a tree*" (Toko Farmer 15). As Toko Farmer 8 explained, "*We make sure that the livestock is not tied closely to a tree as the tree might fall on them*."

The findings reveal that comparable property protection measures were noted in both field sites. Similar to farm protection measures, farmers implemented property protection measures included reactive and short-term behavioural changes prior to a cyclone. Farmers secured their households and farm assets and protected their livestock. Some farmers also mentioned lack of finance for implementing property protection measures which increased their vulnerability to cyclones. Women farmers relied heavily on social networks to secure their property in the cyclone season.

5.2.3 Personal protection measures

Personal protection measures were documented in both field sites. After very fearful and traumatising experience of TC Winston, farmers from both field sites mentioned "*staying informed and alert during the cyclone season through the radio*" (Toko Farmer 15). According to Barotu Farmer 12, "*TC Winston has set an example for everyone. Now, we are very alert*." Barotu Farmer 1 highlighted the importance of staying prepared:

> For example, TC Winston came very suddenly, and we were not able to prepare ourselves. The radio had informed us that TC Winston will affect Suva or will head towards Tonga. But suddenly it turned towards us and so we did not have sufficient time to prepare ourselves. That is why we have gone through a big trauma to save our lives and we almost died. If we had not taken shelter in our car, then we would have surely died.

The sudden increase in intensity of TC Winston and the sudden change of direction should be a warning for farmers to be fully prepared for future cyclone events. However, after the trauma from TC Winston, farmers expressed fear and anxiety while preparing for the cyclone. Many farmers voiced concerns regarding their safety. Barotu Farmer 19 stated, "*The only thing we are concerned about is saving our lives*." The fear and trauma experienced by farmers could act as a barrier for implementing successful adaptation measures placing farmers' lives at risk. Toko Farmer 10 added, "*There is nothing we can do during the cyclone. The only thing that we can do is save ourselves*." Consistent with this research findings, research by Morrisey and Reser (2003) highlighted that in cyclone prone communities,

chronic anxiety, avoidant coping styles, and prior traumatic experience could act as a vulnerability factor and impede psychological and physical preparedness for cyclones.

On the other hand, some farmers mentioned preparing well for the cyclone. Farmers collected necessary food items, batteries, a torch, and a first aid kit before a cyclone. Barotu Farmer 14 mentioned, "*We collect necessary food items and first aid kit. We also have a backup generator*." Farmers from Toko settlement also prepared for the cyclone in a similar manner. Toko Farmer 15 said, "*We have to gather kerosene, torch, and batteries [....] and all other essential things*."

Furthermore, many communities in Fiji have an evacuation centre where vulnerable households can seek shelter during disasters such as cyclones and floods (Lal, Rita & Khatri 2009). Farmers from Toko settlement highlighted that they have an evacuation centre nearby. Despite the severity of cyclones, farmers "*do not go to the evacuation centre. No matter how strong the cyclone is. We prefer to stay at home*" (Toko Farmer 4). Toko Farmer 2 added, "*Yes, the school nearby is an evacuation centre but we do not go there. We do not leave our house*." Farmers prefer to stay at home so that they can "*look after their house and their livestock*" (Toko Farmer 18). The decision to stay home during severe cyclone puts farmers' lives and their families at risk from cyclones and flash flooding. Supporting this claim, Toko Farmer 19 stated, "*We are very careful now, especially after TC Winston. We almost lost our lives in TC Winston*."

On the other hand, Barotu farmers do not have an evacuation centre nearby. Due to an absence of an evacuation centre, many farmers had "*nowhere to go*" (Barotu Farmer 17). Although no one has been injured during recent cyclone (Barotu Farmer 6), the absence of an evacuation centre limits the effectiveness of personal protection measures. Agreeing with this, Barotu Farmer 7 recalled, "*No, with TC Winston we just stayed in our backyard during the cyclone and did not seek shelter elsewhere.*" Given the severity of recent cyclones and due to absence of an evacuation centre, farmers requested the government to build an evacuation centre in the community. Raising concerns, Barotu Farmer 17 highlighted:

> There is no evacuation centre nearby but the next community has one. The evacuation centre is in the Fijian village nearby. It is a good thing to have an evacuation centre so that we can evacuate when needed. Since this is a low-lying area, and it gets flooded quickly. I think the government should assist and make an evacuation centre here so that people are safe during this time.

Moreover, Barotu farmers with weak structural houses evacuated to their neighbours' home. Barotu Farmer 4 mentioned, "*We had to leave our house when the roof was blown away and we stayed at our neighbour's place for a few days*." The results suggest that due to strong social capital through community bonds, farmers assisted each other by providing shelter and keeping most of their neighbours safe.

The results from this section indicate that farmers undertook personal protection measures to cope with cyclones. The results show that after TC Winston, some farmers highlighted facing trauma in preparing for cyclones. Many farmers implemented personal protection measures to prepare for cyclones. Additionally, due to lack of an evacuation centre in Barotu settlement, farmers requested the government to build an evacuation centre in the community. Social

capital also played a crucial role in keeping farmers safe during the cyclone.

5.3 Evidence of loss and damage from cyclones in sugarcane communities

According to McNamara et al. (2018), L&D is the adverse impacts of climate change and climate variability that people have not been able to cope with or adapt to. L&D may vary from one community to the next and include economic, non-economic, tangible, intangible, as well as reversible and irreversible impacts on households, farms, infrastructure, ecosystems, and culture (Ohdedar 2016). Examining L&D is crucial because it provides an opportunity to address the underlying root causes of vulnerability, social inequality, and as a means to increase resilience in SES (Roberts & Pelling 2019). This section of the research documents L&D from cyclones in Barotu and Toko settlements. Finally, Table 5.1 categorises L&D into avoided, unavoided, and unavoidable L&D.

5.3.1 Loss and damage of crops

Despite implementing farm protection measures, farmers from Barotu and Toko settlements experienced devastating L&D in their sugarcane and cash crop farms from TC Winston. Since farmers were unable to implement any effective adaptation measures in their sugarcane farms, most of farmers stated that "*we lost everything*" and "*everything was completely destroyed. Our farm was completely wiped out*" (Toko Farmer 19 and Barotu Farmer 1). Barotu Farmer 14 explained, "*Our farm can produce almost 200 tonnes of sugarcane. But during TC Winston, we produced only 30 tonnes of cane. We lost almost 90 percent of our yield.*" Barotu Farmer 15 also indicated:

> We are not able to produce as many tonnes of sugarcane due to the cyclone as we used to before. In the recent cyclone, we lost 100 percent of all our crops. This was a very hard time for us.

The results suggest that current coping and incremental adaptation measures were insufficient to avoid farm losses in cash crop fields. Farmers from both fields mentioned that "*all the cash crop by the river was washed away*" (Toko Farmer 7). Agreeing with this, Toko Farmer 3 mentioned, "*The heavy rain brought in massive flood, and this swept away all my cash crop. I lost almost half of my watermelons.*" Loss in cash crop yield was also noted in recent cyclones. Although recent cyclones in Fiji have not been as severe as category five TC Winston, farm losses were still experienced under same coping and incremental measures. Toko Farmer 19 explained at length.

> The cyclone swept through my farm and nothing was left. After that, we went through a difficult time. We did not know what to do. It hit us really bad and it took a while for us to get back on our feet. The recent cyclones have not been that destructive but we still lost about 50 percent of our crops.

Moreover, farmers mentioned that it was very difficult for them to witness the L&D in their farms as farmers had "*put in a lot of effort*" (Barotu Farmer 6). Many farmers got "*really worried after seeing the destruction caused by the cyclone*" (Toko Farmer 11). Barotu Farmer 1 expressed, "*After the cyclone passed, we did not even want to go into our farms. Nothing was left.*"

The adaptation measures were insufficient to avoid farm losses in cash crop fields as well. For example, farmers were unable to undertake adaptation measures in their sugarcane farms

which resulted in severe loss. Similarly, insufficient adaptation measures were implemented in cash crop farms, resulting in severe losses.

5.3.2 Loss and damage to property

Regardless of implementing property protection measures, farmers from Barotu and Toko sustained unavoidable L&D to their houses. In most cases, farmers mentioned that "*TC Winston completely destroyed my house. My house was completely gone*" (Toko Farmer 12). Barotu Farmer 4 stated, "*We tied our house and cut down all the nearby trees. However, with the recent cyclone we faced a lot of damages. A big portion of my house was blown away*." Barotu Farmer 12 recalled his experience with TC Winston:

> Half of our house was blown away. After our house was blown away, we ran to the nearby farm which had big culverts and we stayed there overnight. We struggled a lot during the cyclone. I had to carry my old mother on my back to a safe place. The wind was so strong that we could not walk upright - we had to crawl.

After farmers' houses were lost, many farmers became homeless and "*had no place to stay*" (Barotu Farmer 6). After losing their homes, farmers mentioned that "*the following day, we collected whatever housing materials we could find such as roofing iron and made a small shelter for ourselves*" (Barotu Farmer 9). Unfortunately, many farmers stayed in temporary shelter "*for more than six months*" and farmers "*did not stay with anyone else because everyone here was affected and faced the same situation*" (Barotu Farmers 5 and 6). One farmer from Barotu settlement also mentioned that she has started to rebuild her house but even after three years it is still "*partially complete*" (Barotu Farmer 6). The results suggest that due to increasing intensity and frequency of cyclones, the extent of L&D is so severe that poor farmers are still recovering in partially built houses. As a result, higher adaptation measures are urgently required to prevent L&D, or if that is not possible, address the very important L&D from severe cyclones.

Apart from damages sustained to their houses, the heavy rain and winds also damaged "*household items, furniture, bedding, and everything was wet*" (Toko Farmer 20). Toko Farmer 2 added, "*The rain was so bad that the water came into the house and flooded the house. The ceiling also swelled up. A lot of furniture and other household items got damaged*."

The findings indicate that despite undertaking property protection measures (as discussed in Section 5.2.2), many farmers experienced L&D on their property. Most farmers also became homeless and had to survive in tents for more than six months. Poor and marginalised farmers are still recovering from their losses and living in partially built houses. Given the severity of the cyclones, evidence from this research suggests that current property protection measures are insufficient resulting in L&D.

5.3.3 Loss of livelihood and income

After TC Winston, farmers experienced loss of livelihood and income which increased poverty levels (Rowan Gard & Veitayaki 2017). Due to the L&D in farmers' sugarcane and cash crop farms, farmers' "*income was drastically reduced*" and "*all our hard work was gone*" (Toko Farmer 7 and Barotu Farmer 2). Barotu Farmer 1 disclosed loss of income from

his cash crop. "*We lost all our cash crops such as okra. For a smallholder farmer like myself, I can earn $200-300 a week just for okra but I lost all this due to the cyclone*."

Due to loss of income, farmers expressed concerns that "*it was a very difficult time*" and "*we faced a lot of financial hardship*" (Toko Farmers 4 and 7). Many farmers mentioned that due to loss of their livelihood, farmers had to "*start all over again*" (Toko Farmers 8). However, starting all over again or recovering from TC Winston proved to be difficult as "*there was no cash crop to sell to earn an income because everything was ruined*" (Toko Farmer 2). Due to lack of household income, farmers from both settlements mentioned that "*it took us a while to get back on our feet*" (Barotu Farmer 13). Barotu Farmer 7 explained, "*Once a farmer is hit hard like this, it takes time to recover, and we have to put in more effort than before*."

Moreover, as mentioned in Section 5.2, most female farmers could not implement farm and property protection measures and had to bear the consequences of recent tropical cyclones. Consequently, the majority of female farmers stated that the impact of TC Winston and severe L&D affected their socio-economic standards. As a result, the findings suggests that L&D is not homogenous and varies according to gender with women farmers particularly severely affected. One lady farmer emphasised, "*I think that due to Winston, we have been set back twenty years. We lost everything. Now we are slowly trying to recover*" (Barotu Farmer 6). The research findings from Barotu and Toko settlements is consistent with findings of Warner & van der Geest (2013) who strongly suggested that despite implementing coping measures, vulnerable households still faced L&D which had an impact on their livelihood, their income, and their socio-economic status.

Loss of crops and income also have a cascading impact on farmer's family threatening food security and their children's education. Toko Farmer 15 said, "*My income depends on what I have in my farm. The things we eat daily such as banana gets washed away then we are left with very little to eat*." Another farmer expressed concern as his children's education was affected. Toko Farmer 1 stated:

> When the cyclone hits, I lose all my matured sugarcane. During this time, I lost 100 tonnes of sugarcane - almost half of my crops were damaged. This also affects my income and I get worried because I need to send my three children to school.

The results indicate that due to L&D experienced in the farm, farmers faced loss of livelihood and income. Due to loss of income, many farmers faced difficulty in recovering after the cyclone. For instance, female farmers reported that the L&D sustained on their farms affected their socio-economic conditions and their standard of living. As a result, female farmers suffered severe L&D compared to male farmers. The loss of livelihood and income also resulted in cascading impacts such as food insecurity and difficulty in sending children to school.

5.3.4 Non-economic loss and damage

Climate-induced non-economic loss and damage (NELD) includes losses and damages that cannot be measured or compensated financially (Hirsch et al. 2017). NELD include loss of life, loss of burial ground, loss of biodiversity, and loss of land (Tabe 2019). The interviews for this research were conducted three years after TC Winston. However, many of the

participants preferred to talk about and recalled their experience with TC Winston because "*Winston was a very scary experience and since then have are traumatised*" and hoped that the "*same severity of cyclone does not come again*" (Barotu Farmers 18 and 11). Toko Farmer 2 emphasised:

> Facing such loss and damage in the farm and in the house is not normal. We do get smaller cyclones but we have never experienced anything like TC Winston before.

A report on TC Winston by Esler (2016) indicated that a total of 44 people lost their lives during TC Winston. Fortunately, the two settlements did not face any deaths. One farmer was thankful that no one was injured during TC Winston. Barotu Farmer 14 stated, "*During TC Winston, it was a very bad situation. We had very strong winds and rain. We are lucky that we survived that cyclone*."

Having witnessed severe destruction during TC Winston, many residents are now scared and "*fear for our lives*" because "*the cyclone could have killed us*" (Barotu Farmer 13 and Toko Farmer 20). Toko Farmer 5 recalled, "*Last time, during TC Winston, the electricity post near our house fell. This was quite dangerous as it could have fell on our house and could have killed us*." After experiencing the severity of TC Winston, one farmer highlighted that, "*when the cyclone is near, we forget about our farm, and we hide in our house - praying for our lives*" (Barotu Farmer 1). It is evident that in cyclone prone communities, the traumatic experience, anxiety, and fear could trap farmers and undermine their progress. Barotu Farmer 11 emphasised, "*If we do not come out of this trauma, then we cannot move ahead*."

Additionally, farmers from both communities greatly value their livestock (such as chicken, duck, and goats) and they are largely for subsistence production. Farmers categorised elements of the loss of livestock as NELD because the loss of livestock is not compensated by the government. As a result, many farmers have been unable to purchase new livestock to support their livelihoods and farming activities. Barotu Farmer 16 is quoted at length.

> As farmers, we take precautions to save ourselves but our livestock suffer and at times they die. This is a non-economic loss for us. We do not receive assistance for lost livestock. Our livestock is very important for us as we use it to plough the land.

More importantly, Hindu farmers categorised the loss of cattle as NELD because "*cows are sacred animals and have religious significance*" (Toko Farmer 19). Cows also provide milk and are a source of *ghee* (clarified butter) which are used in prayers or worship of Hindu gods (Barotu Farmer 20). Toko Farmer 18 said, "*We also value our cattle a lot. Losing them during the cyclone is a very disheartening experience*."

Respondents also reported deteriorating emotional well-being after seeing the destruction on their farms. Given the severity of TC Winston, some farmers also faced "*great uncertainty*" and "*did not know what to do*" after the cyclone had passed (Barotu Farmers 20 and 17). Farmers also expressed feeling "*lost and sad*" and "*trapped*" (Toko Farmer 18 and Barotu Farmer 16). In some cases, the extent of NELD is so severe that farmers did not know how they would "*survive and feed the children because everything was gone*" (Barotu Farmer 20).

Older farmers also classified loss of their homes as NELD. Many farmers considered loss of homes as a significant NELD because their family home "*has been here for many generations*" and stored many intangible memories collected over many generations (Toko Farmer 14). Toko Farmer 18 stated:

> This was my grandparents' home. After the damages that it sustained, I was very sad and traumatised. We did not expect so much damage. It was very sad losing this house.

Toko Farmer 20 also highlighted:

> The sad thing was that we had this house for three generations. Losing a part of the house was like losing a part of me. For me, my kids, and grandkids have grown here. We have their memories here. So, the damage to the house affected me badly. After TC Winston, I fell sick. I was worried about my house.

In addition to loss of home, some farmers also mentioned loss of place of worship during TC Winston. In many cases, places of worship or temples are located next to farmers' house. Barotu Farmer 1 said, "*My place of worship was ruined, and I was very sad*." Toko Farmer 8 also added, "*I lost my temple during TC Winston*." The loss of place of worship and temples represent a significant NELD because Indo-Fijian farmers have established places of worship through priests and prayers rituals. Places of worship hold religious significance as these places are used to perform prayer rituals on a daily basis as well as major prayer rituals. For example, Toko Farmer 8 mentioned, "*Prayer ritual are conducted for good harvests. During drought, we start praying for the rain and leave everything up to the Almighty*."

Farmers from both settlements reported NELD which included trauma, uncertainty, fear, loss of home, loss of place of worship, and loss of livestock. Even though at the time of the interview, it had been three years since TC Winston, farmers sill expressed fear and trauma when recalling their experience with TC Winston.

The table below categorises L&D from cyclones into avoided, unavoided, and unavoidable L&D. Verheyen & Roderick (2008) identified three categories of L&D: avoided, unavoided, and unavoidable L&D (as discussed in Section 2.4). Table 5.1 indicates that the majority of L&D from recent severe cyclones is categorised as unavoidable L&D. The result from this research strongly suggests that current adaptation measures for cyclones are inadequate resulting in unavoidable L&D.

Table 5.1 Avoided, unavoided, and unavoidable loss and damage from cyclones

Avoided	**Unavoided**	**Unavoidable**
Loss of life	Loss of livestock	Damage to property
		Loss of crops
		Loss of livelihood
		Loss of income
		Non-economic loss: Trauma, fear, and uncertainty, loss of home, loss of place of worship, loss of livestock

5.4 Adapting to drought

Climate change adaptation refers to adjustments in human system in response to actual or expected climate stimuli or their effects or impacts that moderate harm or exploit beneficial opportunities (McNamara & Buggy 2017). Barnett (2001) emphasised that adaptation in SES includes modifying social and ecological systems to accommodate for climatic events. Climate adaptation measures for drought in Barotu and Toko settlements included bearing the effects of drought in sugarcane farms, incremental adaptation such as ensuring reliable supply of water for farm and household consumption, planting less and modifying food consumption, relying on family support and personal savings, and selling livestock. Systems adaptation included seeking off-farm employment and income diversification. The section below discusses drought adaptation measures implemented in Barotu and Toko settlements.

5.4.1 Adapting with reliable water supply

The most widely adopted adaptation measure in both settlements included preparing for drought with reliable water supply for farm and household consumption. According to Barotu Farmer 3, "*During the drought, we do what we have always done. We look for water. We go to the river and get the water for the farm. We also have to look for drinking water and water for household consumption*."

No adaptation measures are undertaken in the sugarcane farm due to the lack of a formal irrigation systems. "*The sugarcane farm is left as it is*" and the "*sugarcane appears dried up*" (Barotu Farmer 16 and Toko Farmer 18). Adaptation measures in both settlements are usually geared towards maintaining the cash crop farms as this is a "*regular source of food and income for the household*" (Toko Farmer 16). Barotu Farmer 14 explained, "*We only water the cash crops so that we have vegetables to eat and sell*."

Access to physical assets such as water pumps assisted farmers in watering their cash crops. Barotu Farmer 15 said, "*We have to use our water pump to get water from the river during the drought*." Similar adaptation measures were noted in Toko Settlement. According to Toko Farmer 1:

> Normally during the drought, we water the cash crops with the water pump. We are lucky that we have water pump. Otherwise, it would be very difficult to go to the river and carry buckets of water.

The use of water pumps for watering cash crops is regarded as an incremental adaptation and may provide some benefits against drought conditions. However, the use of water pumps has limitations. Farmers from Barotu and Toko settlements that utilise water pumps mentioned that using water pump "*is too costly as it requires a lot of fuel, and we need money for the fuel*" (Toko Farmer 11). Due to the expenses involved, farmers prefer to use drums to water the crops. While using drums to water cash crops is less expensive, it is more labour and time intensive. According to Barotu Farmer 20, "*During the drought, we use water pump. But we prefer to use drums to water our field as it is less costly but requires more labour*."

Similarly, farmers who did not have access to water pumps had "*no option but go to the river and carry buckets loads of water to water the plants*" (Toko Farmer 19). Many farmers reported that manually watering the cash crop "*is very tiring work, especially in the heat*"

(Barotu Farmer 10). Therefore, households' access to a water pump is regarded as a valuable asset in both communities. Toko Farmer 16 stated:

> I need a water pump so that my vegetables grow in the drought and so I do not have to go to the river [….] But it is also difficult over here to get access to water pump. The agricultural officers do not give us water pumps.

The lack of access to assets such as water pumps further marginalises poor farmers and exacerbates their vulnerability to drought. It can be said that farmers with physical assets such as water pumps proved more adaptive than farmers without physical assets. This result is also consistent with findings of Currenti et al. (2019) indicating that household's ability to adapt to climate change is influenced by access to livelihood assets such as physical, financial, and social assets.

Furthermore, Toko settlement had regular supply of water for household consumption during the drought. However, during severe drought, farmers "*have a well*" that "*we can use during the drought*" (Toko Farmers 16 and 17). On the other hand, Barotu settlement faced challenges with water supply during drought. Farmers in Barotu settlement have adapted to drought by investing in alternative sources of water such as boreholes and water tanks. Barotu Farmer 20 mentioned, "*Since we face water issue here, I have invested in borehole for household use*." Households with water tanks were most vulnerable during drought as their water tanks were not filled on time. This led to lack of water for cooking and cleaning. Barotu Farmer 10 stated, "*During drought, we have to put in request to get our water tank filled. If we do not get this request in, there is no water*." Extended family also had to share limited water among themselves. Barotu Farmer 11 also explained:

> The water tank does not get filled on time. When the water tank is filled, then I have to ration the water with my brother-in-law. They give us water for only one week. If the water finishes, then we have to look for our own water. It becomes very difficult for me.

The findings from this section indicate that due to lack of a formal irrigation systems, the sugarcane farm is not watered during droughts. Farmers water their cash crop fields to maintain food security and flow of income into the household. Households that had access to physical assets such as water pumps were less vulnerable than farmers without physical assets. While the Toko settlement had a regular supply of water during drought, water supplies to households in Barotu settlement were limited during drought. As a result, households in Barotu settlements invested in boreholes and water tanks. However, households with water tanks faced difficulty getting their water tanks filled on time which increased their vulnerability to drought and constrained household adaptation.

5.4.2 Planting less and modifying food consumption

Another adaptation measure adopted by farmers during drought included "*planting less*" and "*planting enough for household consumption*" (Barotu Farmers 13 and 17). Yet, planting less or planting only for household consumption is considered an erosive measure because it affects food security and adversely affects household income (Yaffa 2013). Barotu Farmer 20 pointed out, "*We have reduced our yield, and this has affected our household income*."

Farmers from Toko settlement also adapted by planting less and modified their food consumption, that is "*we eat less*" (Toko Farmer 15). Farmers modify their food consumption because "*we do not have fresh vegetables [….] and the prices of vegetables this time is very expensive*" (Toko Farmer 15). Since the drought affects farmers' income and vegetables are very expensive, farmers "*resorted to buying less food*" and also "*relied on tin food*" (Toko Farmers 19 and 16).

The results from this section indicate that farmers adapted to drought by planting less and planting only for household consumption. These measures are erosive in longer-term as it affects household income and food security. Farmers from Toko settlement also adapted by eating less and relying on tin food items.

5.4.3 Relying on family support and personal savings

Farmers adapted to drought by relying on social capital through familial support. Farmers who had children engaged in off-farm employment relied on their children's income as support during drought. Barotu Farmer 13 said, "*We have a son that works and because of this we manage well*." Barotu Farmer 19 also added, "*Sometimes, I rely on my son for household expenses as he is employed outside*." Nonetheless, relying on family support as an adaptation measure was inadequate and farmers had to "*fall back on their savings*" (Barotu Farmer 16).

According to Toko Farmer 2, "*We fall back on our savings and rely on our savings to get us through this hardship*." Personal savings were used to "*purchase groceries and to send children to school*" (Barotu Farmer 18). Barotu Farmer 20 added, "*It also gets difficult to send the children to school. So, we rely on our savings*." Barotu Farmer 6 explained:

> We must save up. Once we know that a drought is approaching and we will not have enough income, then we have to save for the drought. We need to save up for food items since we have no crops during the drought.

Yet relying on personal savings also has limitations because it drains farmers' savings. According to Toko Farmer 1, "*So, it is like a vicious cycle. We earn and then we depend on the savings to get us through the financial hardship*."

The interviews revealed that social capital and family support plays a crucial role in assisting farmers adapt to drought. Farmers also relied on their personal savings to buy food and send children to school. Relying on personal savings could be regarded as an erosive measure as it affects household financial security and traps farmers in a vicious cycle of poverty.

5.4.4 Earning extra income

Since farmers experience reduced sugarcane and cash crop yield, farmers earned extra income during drought by selling their livestock and seeking off-farm employment. Many poor households resorted to selling their physical assets such as cows due to lack of harvest and lack of income during severe droughts. According to Barotu Farmer 14, "*We sell our livestock during the drought if need be*." Faced with severe drought, farmers from Toko settlement were also compelled to sell their cows. Toko Farmer 11 also added, "*We have very little income during this time. At times, we have to sell our livestock.*" Although selling livestock such as cows provides a source of income for farmers, this adaptation strategy is seen as an erosive strategy as these households will be "*unable to plough their fields*" when the next

planting season arrives (Toko Farmer 17). Such erosive measures could endanger future livelihood security and household income (Warner & van der Geest 2013).

Few farmers in Toko settlement also mentioned seeking employment to meet household expenses. Both farm and off-employment are used to buy food, send children to school, and cater household expenses. Toko Farmer 2 stated, "*During this time, my husband drives a truck, and we have to rely on his income for household expenses*." Toko Farmer 3 explained:

> We try our best to plant whatever we can. If not, then we normally look for employment outside. This is why I decided to go and work outside. There are bills I need to pay, and I need to look after my family as well.

Evidence from this research suggests that farmers from the settlements resorted to selling their livestock during drought to earn income. However, this is seen as an erosive measure as farmers will face difficulty in land preparation for the subsequent plating season. Some farmers also engaged in off-farm employment to meet household expenses.

5.4.5 Assistance from extension officers

Farmers from Barotu and Toko settlements raised concern that there is very little support from the agricultural extension officers during drought and "*we are left to manage on our own*" (Barotu Farmer 8). According to Barotu Farmer 8, "*No, I have not received any advice from the agriculture officers during the drought. In fact, I have not seen the agricultural officers to date*." Farmers from Toko settlement also raised similar concerns and frustration. Toko Farmer 11 said:

> We receive hardly any assistance during this time. Even when there is supposed to be an assessment done there is nothing done here. Even when we go to the agriculture office asking for seeds, they say that they do not have any seeds. This is very sad. How are farmers supposed to survive like this?

Lack of support and engagement from the extension officers limits opportunities for systems adaptation. Consequently, social transformation is necessary to transform the behaviour of extension officers and farmers to enable better engagement and the trust between the two parties. Due to lack of extension officer engagement, some farmers have adopted "do it yourself" attitude and "*we do what we think is right*" (Barotu Farmer 8). Since "*the agricultural officers do not come to advise us or help us prepare during the drought*", many farmers have implemented erosive measures such as "*selling our livestock*" (Toko Farmer 2 and Barotu farmer 14). Therefore, institutional support and guidance is essential so that farmers can undertake adequate adaptation measures and do not implement erosive or maladaptive measures which could undermine their household security in the future.

Lack of support from the government was also noted during drought. Farmers from both settlements agreed that "*the government needs to be good to us and look after us*" (Toko Farmer 8). Barotu Farmer 5 added, "*We manage somehow during this difficult time. We do not receive assistance from the government during this drought*." Toko Farmer 18 added, "*So when the government is not able to help, we are also not able to do much. We leave it as it is*." Toko Farmer 4 expressed frustration at the current government.

> The government can only talk [….] I see all these government officials moving around in the air-conditioned vehicles. They do not know what it is like to work in the field in the hot sun. These are all taxpayer's money. There is also a new policy by the agriculture. They want to know what farmers are planting, what materials have you borrowed, your Tax Identification Number and your farm number. I think this is for the tax. This is waste of time.

The lack of support from the extension officers at the community level has forced farmers to manage on their own and adopt a 'do it yourself attitude'. As a result, farmers are implementing adaptation measures they think is right and within their capacity for sustaining their livelihood, including erosive short-term coping measures such as selling of cows. Farmers also raised concerns regarding lack of government support which further marginalises farmers and increases their vulnerability to drought.

5.5 Evidence of loss and damage from drought in sugarcane communities

Drought is described as a "creeping disaster" and extensive L&D have been documented across the PICs due to drought (Iese et al. 2021). Severe droughts in Fiji have caused devastating socio-economic loss and physical and structural damage (Rhee & Yang 2018). This section documents L&D resulting from droughts in Barotu and Toko settlements. The findings suggest that the most notable L&D included L&D to crops, loss of income, and NELD such as uncertainty. Lastly, Table 5.2 categories L&D into avoided, unavoided, and unavoidable L&D

5.5.1 Loss and damage of crops

Farmers from Barotu settlement indicated facing severe loss of sugarcane yield. Additionally, despite manually watering cash crop fields, loss in cash crop yield was also noted. Barotu Farmer 15 mentioned, "*During the drought, we lose majority of our cash crops. Sugarcane is also affected*." Barotu Farmer 18 added, "*We do face reduction in yield during severe drought. Both sugarcane and cash crops are affected*." Barotu Farmers agreed that the loss in yield could be avoided if the "*agricultural extension officers advise us during drought*" (Barotu Farmer 1).

One farmer from Barotu highlighted that even though they face "*reduction in yield for our crops. But it is not as severe as other areas such as Yaqara and Tavua*" (Barotu Farmer 19). Since Toko settlement is located in Tavua, a more drought prone area, loss of crops documented in Toko was more severe. Farmers from Toko mentioned losing "*more than 50 percent of our sugarcane and cash crops*" (Toko Farmer 2). Toko Farmer 5 emphasised, "*During the drought, we lose most of our sugarcane. For example, if you were expecting 70 tonnes of sugarcane during the drought it gets reduced to 20 tonnes*." Toko Farmer 1 highlighted:

> When we are faced with long-term drought, the sugarcane farm starts to dry up and we can notice the changes within months. Within seven months, the matured and newly planted crops start to dry up. For me, I lost almost 100 tonnes of sugarcane.

One farmer emphasised that loss of sugarcane yield is due to the inability to water the sugarcane field. Toko Farmer 17 pointed out, "*Roughly, we loss about 50 percent of*

sugarcane during a severe drought. This is because we are unable to water the field." The results indicate that farmers are aware of the main reason for loss of sugarcane yield which is lack of an effective irrigation system. Considerable loss of crop yield can be avoided through proper irrigation systems. However, due to lack of support from the extension officers and the government (as mentioned in Section 5.4.5), farmers have been left to manage on their own and are forced to accept the loss in their sugarcane field.

Farmers from Toko settlement also noted that "*the cash crops do not germinate*" and "*do not flower*" (Toko Farmers 19 and 16). During severe drought, "*our vegetables do not grow even when we water the crops*" (Toko Farmer 15). Toko Farmer 6 also agreed, "*No matter how much water we provide in our field, the crops do not grow*." The results indicate that current adaptation measures undertaken in cash crop field, that is limited to hand-watering, is insufficient to avoid L&D. Therefore, loss in cash crop yield could be avoided if farmers have access to water pumps and irrigation systems.

The results indicate that both Barotu and Toko settlements face loss of crops. Loss of crop yield was more severe in Toko settlement due to its geographical location. Farmers from Toko settlement also observed crop growth and development is severely affected by drought. The results strongly suggest that adaptation measures undertaken in the farm is inadequate to avoid loss of crop yield.

5.5.2 Loss of livelihood and income

Loss of crop yield directly impacts farmers' livelihood and income. Farmers from both Barotu and Toko settlements experienced "*reduced income*" due to loss of crop yield (Toko Farmer 13). As mentioned by Barotu Farmer 15, "*The loss of crops also has an impact on our income and the household*." Barotu Farmer 19 also agreed, "*We have reduced yield, and this affects our household income*." Similar experiences are noted in Toko settlement. Toko Farmer 8 said, "*Our sugarcane normally dries up. This affects our income*."

Farmers from Barotu and Toko settlements also raised concerns regarding their children's educational expenses. Barotu Farmer 4 further explained, "*We lose all our income and face a lot of hardship as we have children. We need money to send them to school*." Farmers in Toko settlement also noted similar cascading effects. Toko Farmer 2 said, "*We also have to consider our household expenses and our children need to go to school*."

Due to loss of income, farmers from Barotu and Toko settlements highlighted that they had to be careful with their "*household expenses*" and farm expenditure as there was no financial assistance for drought (Toko Farmer 6). Barotu Farmer 13 highlighted, "*My household faces loss of income. I have to be careful with how I use my money*." Barotu Farmer 11 added, "*During drought, we lose our crop and our income. We have managed somehow as there is no assistance*." Toko Farmer 20 pointed out:

> We loss more than 50 percent of our sugarcane and cash crops. During severe drought, we loss more than 50 percent of our income. We must be careful with our household expenditures. There is no financial support. So, it is a very difficult time.

The results indicated that loss of income further trapped farmers in climate-induced poverty. This had cascading consequences on household expenses and children's education. Farmers also noted lack of financial support during drought and were left to manage on their own.

5.5.3 Non-economic loss and damage

NELD was also experienced in both settlements. In previous research, Morrissey & Oliver-Smith (2013) have categorised loss of emotional well-being and health as NELD. Farmers highlighted experiencing uncertainty and loss of hope due to drought. Barotu Farmer 1 mentioned, "*We faced a severe dry spell in the last month and only received rain in the last two days. We almost gave up hope during this one-month dry spell*." Toko Farmer 8 added, "*At times, we lose hope that it will rain*."

One farmer mentioned that there is "*nothing we can do during the drought. We just have to wait for it to pass*" (Toko Farmer 4). To cope with severe drought, loss of crop yield, and uncertainty, Toko Farmer 8 mentioned praying to God for rain.

> The sugarcane will start to dry up. During this time, we start praying for the rain and leave everything up to the Almighty. We also conduct prayer rituals for rain and hope that it will rain soon.

Due to the lack of rain, farmers are also uncertain if their crops will grow. Barotu Farmer 16 said, "*Even when we water the crops, it is still uncertain if the crops will grow*." Toko Farmer 8 added, "*We face a lot of uncertainty. During this time, our farming is not profitable. We face a lot of loss*." Barotu Farmer 1 further added:

> We lost a lot of sugarcane during the drought and now that we have replanted. I am not sure how this will turn out. So, as farmers we are faced with such uncertainty and such trauma.

One farmer in Barotu emphasised that she felt uncertain and concerned regarding her limited water supply during drought. Barotu Farmer 11 stated, "*I have to share my water tank. I am always worried and feel uncertain what will happen when there is no water*."

Farmers from Toko settlement reported facing health issues during drought. Toko Farmer 20 added, "*Due to my old age, I have to be careful in the hot weather*." Toko Farmer 16 highlighted:

> The weather is so hot these days and I am asthmatic. I do get sick in this hot weather. Then, I go to the public hospital and wait there for long hours to be seen. Once I went to the hospital early morning and came out of the hospital at 3 pm.

Farmers from both settlements reported NELD which included uncertainty, loss of hope, and health-related issues. To deal with NELD and severe drought, one farmer mentioned conducting prayer rituals and praying to God. This section of the results indicates that NELD goes beyond materialistic losses and could be avoided if proper support and assistance is provided to farmers.

Similar to Table 5.1, Table 5.2 below summarises L&D experienced in Barotu and Toko settlements due to drought. The results indicate that the majority of L&D experienced by farmers can be categorised as unavoided L&D. Unavoided L&D could be avoided through

adequate adaptation measures but were not avoided due to capacity or resource constraints (Verheyen & Roderick 2008). Therefore, L&D from droughts can be avoided by implementing longer-term sustainable adaption measures such as livelihood diversification, access to irrigation and drip irrigation, access to physical assets such as water pumps, advice from extension officers, and secure water supply in Barotu and Toko settlements.

Table 5.2 Avoided, unavoided, and unavoidable loss and damage from droughts

Avoided	Unavoided	Unavoidable
	Loss of income	
	Loss of crop	
	NELD: Uncertainty, loss of hope, health issues	

5.6 Conclusion

This research documented adaptation measures and resulting L&D from cyclones and droughts in Barotu and Toko settlements. Adaptation measures for cyclone and droughts included bearing the effects of cyclones and droughts, coping measures such as reactive and short-term behavioural changes, incremental adaptation, and systems adaptation. No transformational adaptation measures were noted for cyclones and droughts. This research argues that coping, incremental, and systems adaptation are insufficient resulting in L&D. As a result, farmers suffered unavoidable L&D from cyclones and unavoided L&D from droughts. The research findings further suggest that transformational adaptation measures are required to address unavoidable L&D from cyclones. Additionally, unavoided L&D from droughts can be avoided by removing adaptation constraints.

Chapter 6 Institutional capacity to avert and minimise climate change loss and damage in Fiji's sugar industry

6.1 Introduction

This chapter aims to address research objective three which is to assess whether the currently available support and action provided by the Ministry of Sugar Industry are adequate to avert, minimise, and address L&D in Fiji's sugarcane communities. Similar to Chapter 5, to differentiate between distinct levels of adaptation, this chapter adheres to the adaptation framework proposed by Rickards & Howden (2012). This chapter will use this framework to document planned adaptation measures undertaken by the Ministry of Sugar Industry (discussed in Section 6.2) in the face of sudden events (cyclones) and slow-onset events (droughts). In doing so, this research aims to understand the full scope of adaptation measures implemented in Fiji's sugar industry to avert, minimise, and address L&D. Section 6.3 documents and examines L&D faced by the sugar industry despite undertaking planned adaptation measures. Additionally, this chapter categorises residual L&D from cyclones and droughts into avoided, unavoided, and unavoidable L&D as proposed by Verheyen & Roderick (2008) (as discussed in Section 2.4). Sections 6.4 and 6.5 examines assistance provided to communities as part of cyclone and drought response and relief mechanism. Finally, Section 6.6 presents the concluding remarks for this chapter.

6.2 Averting and minimising climate change loss and damage in the sugar industry

This section documents planned adaptation measures undertaken by the Ministry of Sugar Industry in the face of sudden and slow-onset climatic events such as cyclones and droughts. The Ministry of Sugar Industry works collaborates with the Fiji Meteorological Services, the Sugar Research Institute of Fiji (SRIF), the Fiji Sugar Corporation (FSC); the National Disaster Management Office (NDMO), and the Ministry of Agriculture, Environment, and Waterways to implement climate adaptation measures. The section below examines how stakeholders work together to avert and minimise anthropogenic climate change L&D in Fiji's sugar industry.

The adaptation framework proposed by Rickards & Howden (2012) is used to systemically categorise adaptation measures implemented by the Ministry of Sugar Industry. Adaptation measures implemented by the Ministry of Sugar Industry includes both incremental and systems adaptation approaches. Incremental adaptation includes sustainable farm and soil management practices, in-field drainage and irrigation programmes, provision of weather and climate outlooks, and farmer outreach and advice. Systems adaptation includes breeding new climate resilient sugarcane varieties and encouraging livelihood diversification. These adaptation measures are discussed below.

6.2.1 Breeding climate resilient sugarcane varieties

The breeding and distribution of climate change-ready or climate resilient crops is recognised as SES adaptation (Rickards & Howden 2012). One way the sugar industry is adapting to the changing climate is by breeding new climate resilient sugarcane varieties. SRIF has designated ten top commercial sugarcane varieties designed for greater climate resilience. The varieties differ in appearance, germination time, growth duration, soil suitability, cane and sugar yield, resistance to extreme events, and pest and disease resilience (SRIF 2021b). The specific qualities that make some varieties better in face of different climatic events are recognised in the industry. Stakeholder 16 provided a succinct summary:

> Mana variety can withstand floods. Viwa withstands the strong wind. Mana is also a good variety for drought tolerance. Mana, Qabia, and Naidiri - these three varieties can withstand drought. There is one salt tolerant variety that is called Qalowa. Qalowa is good for low-lying areas, especially the coastal areas.

While breeding new sugarcane varieties could provide adaptation benefits under changing climatic conditions, two features of this SES adaptation were found to limit the effectiveness of the systems adaptation. To begin with, because climate change adaptation is a continuous process, the development of new varieties also needs to be continuous. But there is a time lag that throws into question the effectiveness of this adaptation process because "*it takes 10-15 years to release a variety*" (Stakeholder 14). Stakeholder 12 further explained the limitation of this adaptation response. "*By the time you release a variety, the climate has changed a little. But research is such. If we can do everything within one or two years - wow, super. But it is impossible*."

Under the 2019/2020 Fijian government budget, the Fijian government allocated $4 million to the Sugarcane Development and Farmer Assistance programme. The programme provided a sugarcane planting grant to the growers and encouraged the uptake of new sugarcane varieties to increase production (Karan 2020). Stakeholder 11 reported, "*The Ministry of Sugar Industry is supporting the initiative of the sugar research institute in developing a climate resilient cane variety. This variety will sustain the industry in the waves of climate change repercussions.*" There is an expectation from the Ministry of Sugar Industry and key stakeholders that breeding of new sugarcane varieties will solve the challenge of climate change. For example, upon successful breeding, FSC extension officers release new varieties to farmers with the expectation that the communities will adopt the new varieties and maximise their yield and productivity but farmers do not adopt new varieties. The reason is well known, as Stakeholders 16 clearly articulated:

> In Fiji, the problem why farmers do not want to plant another variety is because of the payment system. The new variety may have good sugar content but they are not as heavy as Mana variety. In Western, Mana variety is dominating - it is 95 percent.

This introduces the second limiting feature of the breeding programme which is the lack of uptake of new varieties by the sugarcane farmers even after prolonged periods of breeding and release. The main reason why farmers do not adopt new varieties is because of the current payment system which is based on weight payment system. The current payment system does not provide encouragement to adopt climate resistant varieties.

Therefore, to ensure that the breeding programme is successful, the current system must be transformed to ensure the payment system encourages adoption of climate resilient varieties enabling rational climate adaptation and DRR decisions in face of climate change. Demonstrating this point, Stakeholder 25 pointed out that "*there is a variety called Viwa which is quite resilient to strong winds*" and explained how during the tropical cyclone Winston "*all the cane was flattened down, including the Viwa. but, if you see from a distance, Viwa was still upright*" and concluded that an ecological transformation was also required, namely "*if you know the wind direction, plant Viwa on that side so that your other varieties get protected*."

The Fijian government and the Ministry of Sugar Industry are therefore encouraging breeding and uptake of new climate resilient sugarcane varieties in the sugarcane communities but not in a way that is effective. Breeding climate resilient varieties could potentially provide some benefit against increased climate change. Yet, even though farmers are encouraged to adopt Viwa variety which can act as a shield against severe winds and protect inner rows of sugarcane, farmers still prefer to plant Mana variety due to the sugarcane payment system. Therefore, the current system implicitly continues to promote the planting of the least resilient varieties such as Mana.

6.2.2 Livelihood diversification

Livelihood diversification in SES is important for buffering the effects of climate change and climate variability and promoting social-ecological resilience (Adger et al. 2005; Rickards & Howden 2012). Livelihood diversification could improve household income, enhance social resilience, and extends opportunities for improving overall well-being (Adger et al. 2002). The Ministry of Sugar Industry encourages social transformation by encouraging farmers to diversify their livelihood into "*into cash crops or livestock*" (Stakeholder 16). The Ministry of Sugar Industry considers livelihood diversification an effective strategy to adapt to the changing climatic conditions this "*will supplement farmers' income, ensure food security, and spread-out risks*" (Stakeholder 16). Stakeholder 11 emphasised:

> The way forward for farmers to combat climate change, is that farmers must diversify. They can keep sugarcane but still diversify. Farmers have to diversify so that in case there is a [sugarcane yield] failure, then the other crops can supplement household income.

Moreover, ecological transformation projects, for example, Reforestation of the Degraded Foothills of the Sugar Belt (REFOREST) project provided sugarcane farmers with an opportunity to supplement their income by planting trees on uncultivated land. The REFOREST was funded by the European Union from 2014-2018. This project focused on watershed management and improving livelihoods through reforestation, reducing poverty, and increased income (SPC 2018). The REFOREST project also aimed to increase resilience of sugarcane communities through reducing soil erosion, protecting soil health, increasing biodiversity, and increasing the use of renewable sources of energy to fight climate change (Nasokia 2018). Stakeholder 16 explained:

> There was a project that was funded by the EU. So, that project was for reforestation. So, the Ministry of Sugar Industry was supplied with trees. So, we were supplying trees to farmers so that they could plant on their farms as a sustainable land management practice to deal with soil erosion which is broadly related to climate change.

Likewise, livelihood diversification also encourages opportunities for market exchange. According to Neef et al. (2018) livelihood diversification is a form of adaptation that strategy not only encourages food and subsistence security and can also be coupled with new opportunities for market exchange. The Ministry of Sugar Industry is diversifying its products and expanding its market. For instance, FSC is diversifying its operation into ethanol production. Stakeholder 16 stated, "*If there is an opportunity and we can think about the future, long-term plans, like producing ethanol in Fiji. That is also on our wish list*."

The findings suggest that the Ministry of Sugar Industry promotes adopting diverse livelihood strategies to adapt to the changing climatic conditions, supplement household income, ensure food security, and spread-out climate-related risks. The Ministry of Sugar Industry is also diversifying its products such as production of ethanol. According to Roy & Basu (2020) and Warner et al. (2012), livelihood diversification encourages economic diversification which could enhance rural livelihoods, assist in managing climatic risks, and act as a safety net during disasters.

6.2.3 Sustainable farm and soil management practises

In Fiji, intensive land use, minimum fallow period, and monocropping have drastically reduced sugarcane yield (Wairiu 2017). Farm-level efficiency can be enhanced in Fiji's sugar industry if better farm management practices are utilised (Reddy 2003). As discussed below, the Ministry of Sugar Industry promotes social and ecological transformation by promoting sustainable social and ecological practices.

To begin with, land degradation practices such as "*burning of sugarcane fields is a serious issue*" (Stakeholder 16). Recent research in Fiji has indicated that land degradation is worsening and the leading cause of soil degradation in Fiji's sugar industry is the widespread burning of sugarcane (Mahadevan 2008). Burning sugarcane not only deteriorates soil health and causes soil erosion but also poses a risk during dry periods as fires can spread to other areas (Koroiwaqa 2016). Stakeholder 16 expressed concerns regarding sugarcane burning and its impacts on soil health.

> About 60 percent of the sugarcane is always burnt and supplied to the mill and so that is affecting the sugar mill and the quality of sugar. Before the sugarcane is crushed, the quality has deteriorated.

One reason why sugarcane farmers burn sugarcane is for easier and faster harvesting of sugarcane. "*These are ageing farmers and they have set mentality that they seem to know everything*" but farmers do not realise that such unsustainable behaviour is not only "*seriously damaging the soil and causing soil erosion*" but is also deteriorating the quality of sugar produced (Stakeholders 11 and 16). Therefore, a transformation in farmers' behaviour is necessary to maintain a healthy farm system and good quality of sugar.

Apart from social behavioural transformation, ecological transformation under increased climate change is also necessary. To encourage ecological transformation, the sugar industry is reviving simple yet effective traditional practices such as "*using green manuring technology and using mill mud*" (Stakeholder 15). Green manuring, considered as an integrated nutrient management, improves soil health and yield (SRIF 2021d). Previously, sugarcane farmers would plant lentils and pulses to improve soil quality and fertility. Stakeholder 11 explained the importance of green manuring:

> In the olden days, our fathers and forefathers used this technology called green manuring. They planted lentils and pulses and they ploughed the soil before planting sugarcane. So, that is to improve the soil health and the overall soil condition and fertility.

Additionally, the Ministry of Sugar Industry is advocating the use of mill mud, a mill by-product, instead of chemical fertilisers. Mill mud is regarded as organic fertiliser and has high concentration of essential nutrients required to rejuvenate soils. Stakeholder 16 explained:

> So, we are trying to promote the use of mill mud to farmers. We have set aside some money to promote mill mud. So, we are providing support to farmers to address the soil health and in the longer-term it can help reduce the soil erosion.

The Ministry of Sugar Industry is encouraging farmers to leave their land fallow. In traditional cropping systems, sugarcane farmers would leave their land fallow to restore soil health. However, intensive agriculture in Fiji and increasing economic drive for commercial production has resulted in diminishing fallow periods, lowering soil health and crop yield. Highlighting the importance of soil health Stakeholder 11 said:

> Currently, Fiji's soil is very poor. The old practices of retaining the soil health are forgotten. Previously, what we used to do is leave about 20 percent of the land fallow. So, that in time, it will get back its strength. But, when the economy level was high in sugar, people just went all out - planting, planting, and planting. Over this period of time, the soil health has deteriorated.

To maintain a healthy farm system, the Ministry of Sugar Industry is reviving sustainable farm management practices such as intercropping. Highlighting the importance of intercropping in cash crop fields, Stakeholder 18 stated:

> So, I tell farmers - one of the ways to mitigate the impact of extreme heat is that you intercrop [cash crops] with trees so that the trees give shade. This is because these plants only require certain amount of heat for the physiological process. And if you can help, that is how you can help them.

Intercropping is not only a sustainable farm management practice but also supplements household income. Stakeholder 11 mentioned:

> So, we are encouraging farmers to do intercropping. Some short-term crops together with sugarcane - that can keep them going. This is also additional income for them. Short-term crops are ready in three months - like beans and watermelons.

To demonstrate the importance of sustainable farm and soil management practices, SRIF invites farmers to farmer field days during which grower demonstration plots are observed. According to Stakeholder 25, "*We do some meetings and field days. We have farmer information days*." The grower demonstration plots and farmer field days act as an interactive platform for technology and knowledge transfer. During farmer field days, farmers get an opportunity to discuss sustainable farming practices, ways to enhance crop yield and quality, and mitigating the impacts of climate change (SRIF 2021c).

Yet, the adoption of sustainable ecological practices in the form of climate adaptation remains limited at the community level. For example, during the field visit in Barotu and Toko settlements, it was noted that only mono-cropping was practised, making the farms vulnerable to changing climatic conditions and pest outbreaks. To ensure successful adoption of

sustainable farm practices at the community level, both social and ecological transformation is necessary. Farmer's behaviour needs to be transformed to ensure adoption of sustainable ecological practices. As Stakeholder 11 mentioned, "*So [the behaviour of old farmers are] very hard to change. You need to talk to them a lot*." At the same time, the Ministry of Sugar Industry needs to ensure that the welfare of sugarcane farmers is not neglected.

It is apparent that the Ministry of Sugar industry aims to address long-standing farm and land degradation issues through social and ecological transformation. The results indicate that by encouraging sugarcane farmers to implement sustainable farm and soil management practices against increased degree of climate change, the Ministry of Sugar Industry aims to address pre-existing vulnerabilities and encourage climate change adaptation.

6.2.4 In-field irrigation programme

During drought, incremental adaptation measures provided by the Ministry of Sugar Industry include the provision of irrigation grants and irrigation tanks in drought-affected areas as an adaptation measure. The irrigation grant is provided to farmers with the aim to prevent farm losses during drought. Stakeholder 11 said, "*Through the government, Ministry of Sugar Industry introduced a small grant assistance program where it assists growers in providing irrigation grants*." Stakeholder 16 added:

> We have one programme called the Individual Farmer Small Grant Scheme. For that programme, a farmer can apply for small grant to purchase equipment. That also includes supply of irrigation or water pumps. So, we have been supplying that as an adaptation measure for drought.

The Ministry of Sugar Industry also provides water tanks during drought. The water tanks are "*mounted on the tractors and are called tractor mounted irrigation tanks*" (Stakeholder 16). The water tanks are used to irrigate the field and this service is provided free of charge to farmers. Stakeholder 11 mentioned:

> So, we have an irrigation system whereby we bring in our water tanks. FSC has them. So, we irrigate the field with that. In some areas, for example Ba, we do use water tanks. Farmers do not have to pay for this. They could just use it. They have to liaise with FSC and they could use that.

Additionally, the Ministry of Sugar Industry has been providing farmers with small grants during drought to purchase farm equipment such as water pumps. However, the majority of farmers from both settlements indicated a lack of access to water pumps and highlighted the need for water pump during droughts. This is an indication that the initiatives implemented by the Ministry of the Sugar Industry are not reaching the community level. Accessibility to these initiatives would ensure that the communities take advantage of the initiatives and implement adaptation measures to avoid L&D. At the same time, it is also crucial that the extension officers advise the communities of such initiatives. Stakeholder 18 emphasised:

> [The extension officers] need to be up to date with the latest adaptation measures and this should be going clearly from them to farmers. Farmers are not aware of it and that is an indication that the extension officers are also not aware of these.

The findings reveal that the provision of irrigation grants and water during drought has short-term benefits and does not address underlying SES vulnerability. Rural vulnerable communities are further marginalised because targeted support provided by the Ministry of Sugar Industry is not reaching farmers.

6.2.5 Weather and climate outlooks

The application of weather and climate outlooks in agriculture is becoming increasingly essential (Cliffe et al. 2016; Balarabe, Elisha & Dayyabu 2017; Bezuidenhout & Schulze 2006). The Fiji Meteorological Services provides the Ministry of Sugar Industry with weather forecast called Fiji Sugarcane Climate Outlook. With access to climate services such as the Fiji Sugarcane Climate Outlook, the Ministry of Sugar Industry can provide specific advisory to the sugarcane farmers and improve their planning and decision-making processes. Stakeholder 24 said:

> The Fiji Sugarcane Climate Outlook provides the climate outlook for the sugarcane growing areas for three-six months timescale. This is in partnership with the Sugar Research Institute of Fiji whereby they interpret the outlook and provide specific advisory to farmers and other stakeholders.

Climate outlook or seasonal climate projection could be used as a source of vital information to project which sugarcane growing areas would face wet or dry conditions in the future. Improved planning for dry and wet conditions can improve sugar production, optimise resource use, and improved management practices (Everingham et al. 2002). As a result, the information provided by the climate outlook could be used by the extension officers to assist in social and ecological transformation by providing advice to farmers and guiding appropriate planting materials and actions. Stakeholder 20 explained:

> The Fiji Met. Services can provide climate predictions or climate information that can then inform on a map. For example, that area on a seasonal climate prediction may face drought during the wet season. This information can be quite useful to predict the soil moisture for crops. If you translate this information, the extension people and the research people can make selection of seeds and planting materials and then distribute these to farmers. For farmer, he can then understand why he is receiving certain seeds.

However, the provision of weather and climate outlook as an adaptation measure also has limits due to the unsatisfactory utilisation of climate outlook and seasonal forecasts. To illustrate this claim, a recent study conducted in Fiji regarding the use of climate outlook and seasonal forecasts highlighted that the uptake of climate outlook is insufficient. Stakeholder 24 disclosed:

> So, the Australian government, DFAT, recently undertook a study to determine the use of the [climate outlook and seasonal forecasts]. What they concluded was that the [uptake of forecasts] is not happening at the present. If it is happening, then it is not happening to [a greater] extend. So, there is obviously a gap, and we are working and trying to address this gap.

The government of Australia has contributed significantly to the PIC's response to climate change and climate variability through financing climate-related programs and projects such

as the Pacific Islands Climate Prediction Project (PICPP). The PICPP operated between 2004 and 2012 and aimed to strengthen the capacity of PICs in seasonal climate prediction and providing climate-related information to climate-sensitive sectors such as agriculture, health, and water and renewable energy. A report compiled by Smith & Amjadali (2012) stated that the preparation of seasonal forecasts does not guarantee utilisation of forecasts by climate-sensitive sectors into their planning, decision-making, and management processes.

In Fiji, the PICPP project focused on setting up effective delivery of forecasts for the sugar industry by supporting the transfer of knowledge from Fiji Meteorological Services to sugarcane extension/field officers and then to the farm level. The PICPP supplied APSIM licenses to in-country stakeholders for the duration of the project. However, successive difficulties with the uptake and communication have resulted in the suspension of the project (Smith & Amjadali 2012).

Although the PICPP project may have not been successful, the Fiji Meteorological Services is developing new and innovative ways to disseminate weather forecasts to the extension officers and farmers. Stakeholder 24 mentioned:

> We are trying to work on a decision support tool and through this decision support tool the information could be disseminated through several means such as mobile phone applications or text messaging. Then, we can provide the outlook for the next 3 days, 10 days, monthly, and seasonal outlook. Based on this outlook, it would provide specific advisory to farmers.

Stakeholder 5 highlighted that in addition to disseminating weather forecasts, it is also important that "*everybody in the community understands the weather alert and knows what to do when receiving the information*" (Stakeholder 5). Therefore, the capacity of extension officers to better understand and interpret seasonal climate forecasts is very crucial for improved climate risk management within sugarcane farmer networks. The inability to do so may lead to production loss, affecting farmers' income, livelihood, and food security. Stakeholder 24 stated:

> So, the information is supposed to be communicated to farmers by extension officers. So, the extension officers are supposed to contextualise the information and provide the information to farmers. That is how it is supposed to work. However, there is a need to engage more with the on-field officers. One of the gaps that we see is that the [extension officers] need to be trained in understanding the information and taking it to farmers.

Climate services such as Fiji Sugarcane Climate Outlook is used to provide specific advisory to sugarcane farmers such as improved planning for wet and dry seasons. Through identification of climate-related exposure and sensitivity to wet and dry periods, extension officers can provide farmers with suitable planting materials and advice to minimise climate vulnerability and L&D. At the same time, it is crucial that the extension officers need to understand the climate outlook before disseminating the information to farmers. While the seasonal climate prediction, PICPP, may not have been successful, innovation tools such as mobile phone applications could also be used to disseminate climate outlook in a fast and effective manner.

6.2.6 Farmer outreach support and advice

To minimise impacts of climate change, the Ministry of Sugar Industry in partnership with SRIF and FSC has a farmer outreach component. Farmer outreach component includes sharing new information on social media, media releases, and awareness through the radio. Stakeholder 25 mentioned:

> So, there is an extension component that is outreach to farmers. So, farmers liaise with FSC but that does not stop SRIF from having our outreach programmes with farmers. So, SRIF also has social media pages, we have a Facebook page, we do some media releases, we talk on radio so that farmers get to know that SRIF is there.

Although, it remains crucial that extension officers reach out to the communities and advice the communities to how to adapt to changing climate, however, there are limits to the outreach programmes. To begin with, there is lack of trust between the extension officers and farmers. The reason for this lack of trust between the extension officers and farmers is the lack of engagement and assistance provided by the extension officers to farmers (as discussed in Chapters 4 and 5). Stakeholder 9 pointed out:

> At the moment, farmers do not trust most of those advisory services. When they show up, farmers chase them away. So, we need to strengthen that because the extension officers are the ones working closely with farmers.

To enable adequate adaptation and to overcome the adaptation barrier mentioned above, social transformation is necessary. Social transformation can be achieved by changes in behaviour of the extension officers and farmers. Consequently, "*the main thing that we must do is that the agricultural officer betters the network with the farms in the locality*" (Stakeholder 4). This can be achieved by "*building partnership with farmers and the extension officers*" (Stakeholder 9). This strengthened partnership will facilitate exchange of information and would ensure adequate adaptation measures are implemented to minimise losses. Stakeholder 4 explained:

> So, I think Agriculture officers need to advise farmers that you should plant this type of crops, be careful of this slope, this is the type of crop that is suitable for this area, and it will give you more yield and more income. From the government's side, the extension officer has the technical expertise. He can give advice in terms of pre- and post-disaster. Farmers can also give advice on the types of crops that their forefathers have been planting. From the collaborations and the information sharing, they can plot out a way on how to increase their produce, how they can become resilient, and minimise losses for farmers.

Therefore, specific advisories provided to farmers would allow them to adapt to changing climatic conditions and reduce L&D. For example, specific advisories on planting calendar are essential to avoid losses from cyclones, floods, and drought. Stakeholder 25 mentioned:

> So, we encourage [farmers] to plant between March to May. So, by the time the cyclone comes the cane is generally quite big and they are not entirely submerged, and they have formed nodes and achieved certain amount of growth. So, when the flood comes and they are submerged, they have the ability to recover. If they are

> living in a flood plain and they plant between September to October, then they will lose their cane and this is a high risk.

Investment in agricultural research and development and extension services is particularly important for transformational adaptation. Without targeted agricultural research, farmers are currently left to largely cope on their own (as documented in Chapters 4 and 5).

> In the 1980's, the agricultural sector used to have a very strong research division and all that has disappeared over time. If the research division is not doing well then it gets closed off. So, without research and in some cases even without extension services, you have a farmer that is standing alone without any kind of advice on what will happen in the future (Stakeholder 20).

Another way to encourage implementation of adequate adaptation measures is the establishment of farm associations. Establishing farm associations would act as a catalyst for transformative learning and driving much-needed change in agriculture. Farm associations, placed between the extension officers and farmers, act as "bridging organisation" to cater for the needs of farmers and ensure that farmers understand new products released to them. Recent research in Fiji also highlighted the importance of farm organisations in Fiji's sugarcane belt (Taylor, McGregor & Dawson 2016). Folke (2007) also highlighted that bridging organisations are essential features of adaptive governance that allows for ecosystem management and for responding to environmental feedbacks. Stakeholder 20 emphasised:

> Farm associations are very, very critical agents of change in the agricultural sphere. Farmer association can be inserted between the extension officers and farmers so that they can go back and forth between the needs of farmers and the extension units, and they understand the final product before it goes out to the individual farmer.

The results suggests that extension officers and farmers need to trust each other and work together to ensure that the current and anticipated vulnerability could be reduced and L&D avoided. The research also highlights the significant role of agricultural research divisions and farm associations to reduce vulnerability of rural agricultural communities to changing climatic conditions**.**

6.3 Climate change loss and damage in the sugar industry

Chapter 5 has documented L&D in sugarcane communities from a farmers' perspective. To fully understand the scope of L&D in the sugar industry, this section documents L&D perspectives from ministerial, institutional, and academic stakeholders. Despite implementing planned adaptation measures (as discussed above), key stakeholders from the sugar industry mentioned experiencing severe and devastating L&D due to cyclones and droughts.

6.3.1 Loss and damage from cyclones

Similar to the experiences of the sugarcane farmers, the key stakeholders wished to discuss broader implications of TC Winston. As documented below, the L&D from cyclones are documented to be significant and severe, threatening the sustainability of Fiji's sugar industry. Given the severity of recent cyclones in Fiji, L&D can be classified as unavoidable L&D. Stakeholder 15 provided an overview of L&D from TC Winston:

> The damage due to TC Winston in the sugarcane subsector was valued at FJ$21.8 million with loss of approximately FJ$53.6 million. Damage was mainly sustained to access roads, plants, farm sheds and stores, and major drainage systems. Most of the damage occurred in the Western Division with the highest sugarcane production.

The majority of losses encountered during TC Winston included loss of sugarcane. Most sugarcane communities were severely affected as TC Winston struck during the 2016 planting season (Esler 2016). Production of sugarcane declined drastically with lowest production noted to date and the FSC lost an estimated 3000 tonnes of sugar (FSC 2016). Stakeholder 16 emphasised, "*So, about 50-80 percent of the crop was damaged. So, that year, [the sugar industry] had recorded the lowest production of sugarcane in the entire history of the sugar industry*." It is worth noting that given the severity of TC Winston, no adaptation measures could be implemented to avoid losses. Supporting this claim, Stakeholder 16 mentioned:

> With TC Winston, we really could feel the impact. The wind speed was such that it affected everything. I mean, sugarcane is like a stick that you can break with your hand. So, I do not think that we can create some variety that can withstand category 5 cyclones.

The loss of sugar production adversely affected revenue and foreign exchange earnings (Esler 2016). Significant production losses also adversely affected small-holder sugarcane farmers' livelihood and income (as discussed in Chapter 5). Since most sugarcane farmers are small-scale farmers with an average land holding of 4 hectares, TC Winston devastated farmers' annual production, placing farmers in a difficult financial situation. Stakeholder 16 explained:

> It also significantly impacted the income of farmers. Most farmers in Fiji are small-scale farmers. Around 85-90 percent are very small-scale farmers who have on average 4 hectares as compared to other countries like Australia. If their crop is damaged, so, basically everything is gone - they lose a year's crop, and it becomes financially very difficult for them.

Moreover, the damages faced from TC Winston included damages to vital infrastructure "*such as farm roads, flood gates, buildings and machinery damages, and destruction of nurseries*" (Stakeholder 15). There were damages to "*infrastructure supporting livelihoods such as electricity supply and water*" (Stakeholder 11). Some of the biggest damage encountered during TC Winston by the sugar industry was forced closure of the Penang sugar mill. According to the 2016 annual report compiled by FSC, due to mill's extensive damage and subsequent non-viability of the facility, the FSC Board decided to permanently cease all operations of the Penang sugar mill (FSC 2016). Stakeholder 16 said, "*TC Winston affected the Penang mill, and it has closed for good*."

The stakeholders from the sugar industry also mentioned NELD faced by the sugarcane communities. Similar to Chapter 5, stakeholders mentioned the trauma that sugarcane farmers faced during TC Winston. Stakeholder 16 emphasised, "*So many farmers were traumatised [by TC Winston] - that we could see*."

Additionally, during cyclones, storm surges and flash flooding worsened. Consequently, farmers from low-lying areas are forced to relocate. Stakeholder 11 stated, "*The low-lying*

areas that seems to be constantly flooded, farmers simply have to move and leave their land behind." The issue of relocation is a distressing dilemma where people are forced to leave their birthplace, sever ties with other community members, and face psychological stress and an uncertain future. Stakeholder 16 highlighted:

> For example, in Labasa, we have displacement of farmers and villages from low-lying areas. These people, they are forced to move because their livelihood is important. But they have an attachment to those areas. For some people, it is their birthplace and they are attached to the community. So, when people move, probably some have come to Suva, some have gone to other places - there is a split within a community. Basically, the networking system is disrupted and it can have a prolonged impact on a person psychologically as well as their health.

At times, settling into a new area is difficult. People also have to adopt an alternative form of livelihood (Charan, Kaur & Singh 2018). Many of these farmers have a strong emotional attachment to the land and the sugar industry. Hence, turning away from the industry and seeking an alternative livelihood is a difficult choice to make. Stakeholders 16 pointed out, "*If farmers are asked to come and settle in a new place, the difficulty is that they might not adjusted well, or they will miss their birthplace*." Agreeing with this, Stakeholders 24 pointed out:

> In terms of the non-economic loss, I think the people in the sugar industry have a very strong personal relationship where their forefathers have been in the industry for a very long time - since they arrived from India. So, they have a strong relationship with the sugar industry - especially the older generation. If you ask them to turn away from the sugar industry and do something else, it will be quite difficult for them.

Considering the severity of recent cyclones, the current incremental adaptation measures implemented by the sugar industry (as discussed in Section 6.2) are inadequate to avoid L&D. Supporting this claim, stakeholders pointed out that "*our efforts are negligible in the sugar industry*" and "*we will need to scale up our efforts to address climate change loss and damage*" (Stakeholders 16 and 11). Moreover, if the sugar industry continues on the same pathway without increasing efforts to transform the industry or to address climate change L&D, Fiji's sugar industry will be headed towards a collapse. Highlighting concerns Stakeholder 11 emphasised:

> Apparently, Fiji's sugar industry will encounter challenges to remain operational and exist – an immense drop in the cane tonnage supplied, causing drop in sugar produced, drop in the quantity of sugar exported, less income, employment affected, and increasing poverty.

The results strongly indicate that due to recent severe cyclones such as TC Winston, the sugar industry has experienced severe loss of sugarcane yield and severe damage to critical infrastructure such as closure of Penang sugar mill. The findings also highlighted NELD faced by the sugarcane communities such as trauma, relocation, and loss of historically and culturally significant places. The severe L&D experienced by the sugar industry can be categorised as unavoidable L&D. The empirical findings strongly suggest that the current

effort undertaken by the sugar industry (as discussed in Section 6.2) is insufficient to avoid climate change L&D. Moreover, the results indicate that the stakeholders are aware of the current unsustainable trajectory of the sugar industry. Overall, L&D has severe implications for the survival of the industry. If the sugar industry continues with the same adaptation practices, it will encounter challenges in remaining operational - an indication that the sugar industry is headed towards collapse.

6.3.2 Loss and damage from droughts

This section documents L&D from droughts in the sugar industry. Due to the severe drought conditions and lack of a formal irrigation system, "*farmers find it difficult to maintain their sugarcane field and farmers lose all their crops*" (Stakeholder 16). The current adaptation response implemented by the sugar industry such as provision of irrigation tanks is inadequate as the sugarcane "*appears burnt and does not grow well and the quality of sugarcane provided to the mill is also affected*" (Stakeholder 16). The loss of sugarcane yield during drought "*affects farmers' income*" and places farmers in a financially difficult position (Stakeholder 11). As a result, farmers find it hard to meet household expenses and face food insecurity issues. Stakeholder 25 highlighted:

> During the recent drought, some farmers approached me and informed me that they were facing reduced yields. Due to this, there is reduced income in the household - farmers find it hard to meet household expenses, for example, buying food, paying bills, and meeting medical expenses.

Stakeholders also shared experiences of NELD faced by sugarcane farmers. For example, serious health issues were noted due to severe drought conditions. For example, during severe drought of 2011, "*Fiji's susceptibility to viral disease outbreaks had worsened and Fiji recorded a drought-induced outbreak of diarrheal disease*" (Stakeholder 15).

In addition, during drought farmers do not have access to nutritious food. As documented in Chapter 5, during drought there is lack of cash crops and vegetables are sold at higher market value. The lack of access to nutritious food such as green leafy vegetables is concerning as it affects farmers' health and well-being. Stakeholder 18 mentioned:

> Yes, health issues are non-economic loss. During drought, farmers hardly have leafy vegetables, and this affects farmers' health and well-being.

The L&D documented could also has a cascading impact on the welfare of farmers' families. The impacts are not only felt on livelihood and the health of farmers but also affects education of their children - resulting in "spiralling" and intergenerational impacts. Stakeholder 9 explained:

> The cascading effect is that farmers will not have livelihood and they will not have food. So, they will have access to poorly nutritious food, and they end up relying on food aid. The education of the children is also affected. They may not send their kids to school. These impacts go on and on for a very, very, long time. If farmers do not send those kids to school, then the kids will not get a good education. So, either the kids will go on farming at the same vulnerable area, or they may switch to other forms of a livelihood - such as a job. But, given that they

> do not have a good education, then the kind of jobs they will have will pay less, have high labour demands, high vulnerability, and high-risk jobs.

The findings suggest that L&D due to droughts included loss of sugarcane yield, degraded quality of sugarcane supplied to the sugar mills, and loss of revenue. Farmers faced loss of income which affected household food security and other household expenses. In addition, NELD included health risks are also documented. The L&D documented from drought can be categorised as unavoided L&D. Cascading impacts were also documented which have a "spiralling" and intergenerational impact.

6.4 Tropical cyclone Winston: Disaster response, relief, recovery, and rehabilitation

In Fiji, disaster management clusters have been adopted for improved coordination of disaster responses. The disaster management clusters are groups of organisations and stakeholders that work collectively for humanitarian support. The clusters help to create partnerships with local, national, international bodies, and civil societies. The Fiji national cluster system consists of eight clusters: Health and Nutrition, Shelter, Education, Food Security and Livelihoods (FSLC), Safety and Protection, WASH, Logistics, and Public Works and Utilities (Winterford & Gero 2018). The eight clusters are led by national government agencies with support from international and regional agencies from the Pacific Humanitarian Team. The cluster system originated in 2011 and was institutionalised in the national policy after TC Winston (Baseisei et al. 2019).

The Fiji national cluster system is coordinated by the NDMO and the FSLC is led by the Ministry of Agriculture and co-led by the Food and Agriculture Organisation of the United Nations (FAO). The core functions of the FSLC are to ensure that resilience of farmers is enhanced through the promotion of resistant crops, better farming practices, and adoption of disaster preparedness measures. In addition, the initial damage assessment after a disaster is also conducted by the various cluster groups.

While the Fiji national cluster systems' core function is to coordinate coherent response and recovery, institutional gaps were noted in the coordination of FSLC. Although the stakeholders from the Ministry of Sugar Industry claim that "*we have been working with the national disaster team [….] and assistance was provided to farmers*" (Stakeholder 11). Yet, a look at the FSLC standard operation procedure (SOP) indicated that the Ministry of Sugar Industry is not a member of the FSLC and "*it is usually crop, livestock, and non-sugar*" (Stakeholder 17). Stakeholder 17 further clarified, "*I do not know about the sugar industry. I have not seen them attending any meetings*" These institutional gaps could act as a barrier to facilitate effective coordination with "*duplication of activities*" (Stakeholder 17).

Stakeholder 16 clearly outlined the reasons for the above confusion about the Ministry of Sugar Industry's participation in FSLC. Stakeholder 16 stressed that effective coordination is only possible through close cooperation with partner organisations. Nonetheless, many agencies, international partners, and donors do not realise that the sugar industry is governed by a separate Ministry from the Ministry of Agriculture. Often, any work or any assistance associated with agriculture is taken up by the Ministry of Agriculture.

> One problem in Fiji is that when they say agriculture, they think of agriculture, only the Ministry of Agriculture. They forget that the Ministry of Sugar is also a

> Ministry and sugar is also an agricultural crop. So, most development partners, they don't know that there is a separate Ministry [for sugar] (Stakeholder 16).

After initial disaster assessments, relief supplies are provided to the affected areas. Relief items supplied to the communities during TC Winston included "*tarpaulins, pillows, and blankets*" and "*food items like flour, sugar, and tin food*" (Barotu Farmer 4 and Toko Farmer 19).

In Fiji, after a disaster, the Prime Minister's fund is mobilised for relief purposes. According to Esler (2016), Fiji Prime Minister's fund, also known as the National Disaster Relief and Rehabilitation Fund, can release up to FJ$1 million for any disaster. The recently established Rehabilitation Fund also receives an annual funding of FJ$2 million. However, for disasters such as TC Winston, estimated losses and damages amounted to FJ$1.9 billion, indicating the severity of impacts and L&D, and the government's inability to respond accordingly. The inability to respond to severe impacts and L&D is an example of climate injustice faced by the government of Fiji as these severe impacts are "*destroying the livelihood of people and destroying our culture*" (Stakeholder 7).

Due to the Fijian government's lack of financial ability to address impacts and residual L&D from TC Winston, the government of Fiji declared a state of emergency and requested international assistance (Esler 2016). Accordingly, "*a lot of help came from the public and overseas governments*" (Toko Farmer 9). The items provided by the public included clothes, food items, and bottle watered. Barotu Farmer 16 said, "*We are thankful for the general public that assisted us. We received food items and bottled water*." Barotu Farmer 10 also expressed her gratitude, "*Yes, there was a lot of assistance for food and other materials by the public after the cyclone*." Farmers also received assistance from international community such as "*the Australian government were the first one to help*" with "*military and medical teams*" (Toko Farmers 16 and 20).

Farmers from both field sites also mentioned receiving relief supplies from NGOs. The NGOs provided farmers with food items, building materials, and farming tools. Toko Farmer 5 added, "*We got some material from Fair-trade organisation such as cane knives and some fertilisers*." Barotu Farmer 1 was also thankful for receiving assistance from an NGO.

> The non-government organisation has helped us a lot and in many ways. They gave us food supplies and supplied us with materials to build back our house. NGOs such as FRIEND and other NGOs assisted us a lot.

Farming tools and seeds were provided to farmers by the Ministry of Sugar Industry. One concern highlighted by one of the agricultural stakeholders was that farmers are provided with the "*same crop that was damaged [in the cyclone]. If they send same crops or same varieties, we will face same impacts from the next disaster*" (Agricultural officer 3). Stakeholder 20 added, "*From farmer's perspective, they just come distribute seeds and planting materials and they are off again*." By providing farmers with the same planting materials, SES vulnerability is not addressed, and farmers once again find themselves in the similar unsustainable social and ecological conditions. As a result, systems adaptation is once again inadequate as social and ecological conditions are not improved. Stakeholder 20 questioned:

> Do farmers get things that they want or things that are suited for the ecosystem? The ministry cannot continue to do things like this- it is not effective; it is not efficient. So, this idea of providing seeds after a disaster is very wasteful in some cases. The seeds may be for crops that are not suited to be planted for that particular time.

Furthermore, relief in form of grants were also provided to sugarcane farmers who lost their income. Stakeholder 16 stated that the government of Fiji financed relief program for the Sugarcane Growers Council (SCGC) to pay off debts owed to FSC and the banks. As explained by Stakeholder 16:

> So, financially we had provided assistance to farmers because their income was lost. They were not able to pay the debts that they owed to FSC or the banks. What the government decided was that we will pay off those arrears for that particular year in terms of the land arrears and the other arrears. The government had given as a loan of $1000 to individual farmers who were affected. Later, the government had decided to convert that into grants. So, that was immediate assistance.

Additionally, for the year 2016/2017, the Fijian government's national budget allocated $23.8 million to the Ministry of Sugar Industry - an increase of $12 million from the previous budget (The Government of Fiji 2016). The sugar industry provided funding of $11 million for Sugar Development and Farmer Assistance Programme. In addition, an allocation of $3 million was provided for improvement of cane access roads to allow transportation of harvested cane to mills (Ministry of Economy 2016b). Stakeholder 15 commented, "*There was assistance for cane access road through installation of culverts and Irish crossings*." Stakeholder 16 explained:

> In terms of infrastructure, there was also a lot of cane roads that were damaged. We had constructed the Irish crossing and culverts. We had provided a lot of culverts and upgraded the cane access roads.

After TC Winston, the European Union pledged $23.4 million for recovery and rehabilitation of sugarcane, livestock, crops, and agriculture-related infrastructure (Ministry of Economy 2016b). Stakeholder 16 was thankful for the support and stated, "*After TC Winston, we got $10 million from the EU. So, they have been very helpful to the Sugar Industry.*"

To assist the affected communities during TC Winston, the government of Fiji implemented social protection programmes to provide relief to households. These social protection programmes included Poverty Benefit Scheme, Food Voucher Programme, and Help for Homes initiative (Esler 2016). In addition, people could also access money from their Fiji National Provident Fund (superannuation fund) post TC Winston. However, many farmers do not have Fiji National Provident Fund, leaving the majority of farmers relying on government assistance (Esler 2016).

The government of Fiji also showed commitment to build back stronger by providing Help for Home program to assist in reconstruction (UNDRR 2019). Farmers mentioned receiving assistance from the government for repairing and rebuilding their houses. Financial assistance

was provided to farmers according to the damages faced. The advisory councillor further explained that type of assistance provided by the government after TC Winston.

> The government also had helped many people build back their house by providing money. People had three options: $1,500, $3,000, $7,000. The write-off damage received $7,000.00. A lot of people received this financial aid.

Even though the Help for Home program aimed to assist in reconstructing damaged houses, some farmers claimed that the assistance provided after TC Winston was minimal compared to the damages sustained. Barotu Farmer 18 explained:

> We received $1,200 for the damages but the damage sustained was far greater. I would say that the damages were more than $10,000 but we only received $1,200.

Farmers from Toko settlement also highlighted that the monetary assistance provided was unmatched to loss and the trauma experienced by farmers. Toko Farmer 18 pointed out, "*We received money according to the damages we have faced. But, losing our ancestral home, you can say no money can replace that*." Therefore, NELD presents a good example of an ongoing climate injustice, because vulnerable communities are disproportionally affected by climatic impacts for which "*there is no compensation provided*" (Toko Farmer 11). Therefore, "*those that are responsible for the problem should be paying to address the problem*" because "*loss and damage is also progressive, and these might intensify over the years*" (Stakeholders 6 and 8). Paying for climate change L&D would require "*admission of historical responsibility*" by the developed countries and would require the developed countries to accept the notion of liability and compensation (Stakeholder 2). Many scholars have argued for compensation for addressing L&D, however, this issue still remains contentious while vulnerable communities continue to suffer (Serdeczny, Waters & Chan 2016).

The results have indicated that the Fijian government's initial response after a cyclone is coordinated through the national cluster system. The FSLC is responsible for assessing magnitude of the disaster, initial impacts, and immediate needs of the affected communities. While the sugar industry works with the national disaster team, the Ministry of Sugar Industry needs to be included in FSLC for better stakeholder coordination and response.

Moreover, given the severity of cyclones, it is evident that impacts and resulting L&D go beyond the Fijian government's ability to respond. For instance, the Prime Minister's fund was insufficient to address the losses and damages due to TC Winston. As a result, the Fijian government declared a state of emergency and requested for international assistance. It is evident that the L&D suffered by the Fijian communities also warrants a case for climate justice.

The findings also indicate that severe cyclones and climate change L&D exacerbate pre-existing inequalities and vulnerabilities. As reported by farmers, the agricultural officers only assisted rich farmers and neglected the needs of poor farmers. Consequently, this produces more socially divided versions of communities where poorer farmers were further marginalised due to lack of assistance.

For recovery and rehabilitation purposes, the government of Fiji encouraged people to build back better through the Help for Homes programme. However, farmers expressed concerns

that the assistance provided was minimal to the damages sustained. Farmers also expressed uncertainty if their reconstructed houses would withstand the next severe cyclones, Additionally, farmers highlighted that there was no form of compensation provided for NELD.

6.5 Drought response and management

This section documents drought response measures undertaken by the Ministry of Sugar Industry in drought-affected areas. The research findings indicate that the Ministry of Sugar Industry's response to droughts has several limitations. To begin with, owing to drought's slow-onset nature, "*droughts are not really captured*" and "*the government finds it very hard to know when to trigger the support [for drought]*" (Stakeholders 4 and 9). Stakeholder 9 explained:

> With drought, you will find out that the drought started six months ago and then when you realise you have no water, my crops are dying, and you do not know when it will stop.

Secondly, another limitation noted in the Ministry of Sugar Industry's drought response is the lack of an early warning system and lack of drought responsive plans. Stakeholder 16 mentioned, "*We don't have [a drought management plan] at the moment. We are trying to request funding to get a consultant to get that drafted for us*." Due to the lack of responsive plans in place, the Ministry of Sugar Industry is unable to trigger the emergency response and provide the necessary support to the communities. Stakeholder 9 explained:

> There is no proper early warning system. It is not just the lack of an early warning system but also a lack of responsive processes in place. We do not know when to trigger the emergency. That has been happening during the last drought in Fiji. We do not know when we are going to say that we are now going to declare a state of emergency because the drought is also localised.

As mentioned in Section 6.2.5, the Ministry of Sugar Industry relies on the Fiji Meteorological Services for seasonal outlooks and the forecasting of "*long-term and this short-term drought*" (Stakeholder 4). Once the Fiji Meteorological Services has forecasted an agricultural drought, drought awareness is created over the radio. Stakeholder 16 mentioned, "*So, if we go for awareness or consultations, mostly we do face-to-face consultations or consultations over the radio - farmers like to hear the Hindi radio station*."

During drought, the extension officers "*discourage farmers from planting*" to avoid severe impacts and L&D (Stakeholder 11). While farmers could avoid the impacts of drought by refraining from planting, planting less could affect farmers' household income and food security (as documented in Chapter 5). Therefore, one way to avoid the impacts of droughts and residual L&D is to increase "*make resources available, like drought tolerant crops*" (Stakeholder 9). The availability of drought-resilient crops and the effectiveness of these crops can be further enhanced through "*crop models to determine the threshold or tolerance rather than just saying that this is a drought-tolerant crop*" (Stakeholder 9).

Forecasting droughts also enables relevant stakeholders to assess drought impacts and mobilise resources such as technical and financial assistance to affected communities. However, in most cases, since the drought is captured late, mostly reactive and preventive

response measures are implemented. For instance, the Ministry of Sugar Industry provides irrigation grants and water tanks to irrigate the fields in drought-affected areas. Regardless, the irrigation grants and the provision of water tanks provide short-term benefits and are not accessible to all communities resulting in L&D (as discussed in Section 6.3.2). Therefore, to reduce vulnerability and avoid L&D from droughts in Fiji's sugar industry, it can be argued that current approaches need to go beyond incremental and preventive measures emphasising the need for proactive approaches and transformational adaptation.

In most cases, the government provides water to the affected communities as streams and rivers dry up. However, Stakeholder 9 argued that the ability of households to store water for household consumption and farm use would depend on the household's access to livelihood assets such as water tanks. "*If the government is giving out water and there is no water tank, where will you store the water*?" Evidently, as documented in Chapter 4, having access to livelihood assets such as water tanks is crucial for households affected by droughts. Just as importantly, the quantity of water supplied and refilling of water tanks can also determine household sensitivity and vulnerability to drought.

Apart from providing relief to farmer's households and farms, essential provisions for livestock and crop facilities are also important. Stakeholder 9 emphasised:

> They should also have some form of relief mechanism to help farmers such as access to feeds, have access to water for the livestock, and have access to some storage facilities for the crops.

The findings reveal that earlier forecasting of droughts, and a proper drought response plan will support measures that go beyond incremental and preventive strategies and enable timely mobilisation of resources to agricultural communities. To enable transformative measures within the sugar industry, higher levels of adaptive capacity are required. "*It is not enough anymore just to do things in your silo or within just one sector*" and therefore to enhance adaptive capacity multi-stakeholder approach is required (Stakeholder 20). For example, interviews with other stakeholders such as the Ministry of Agriculture and NDMO revealed that these stakeholders have been collaborating on Drought Management Plan which is currently in a draft stage. The Drought Management Plan for the agricultural sector would facilitate to prepare and respond to droughts successfully. Stakeholder 3 mentioned:

> The NDMO, in collaboration with the Food and Agriculture Organisation of the United Nations, is currently formulating the National Drought Management Plan which will enable the government to tackle the issue of drought in a more systematic and holistic manner.

The Drought Management Plan, called *Early Warning, Early Action Plan*, is divided into two components. The drought *Early Warning* component aims to strengthen existing series of indicators for hazard monitoring and develop thresholds and triggers for different drought phases while the drought *Early Action* aims to implement actions to minimise risks, mitigate impacts, and avoid a disaster. As explained by Stakeholder 18:

> We had a consultant who was our *Early Warning and Early Action* person. He used to work closely with our disaster risk management specialist, and he was working very closely with the Ministry [of Agriculture] and NDMO. We have

> what we call *Early Warning Early Action* for drought. It is a new concept for Fiji. So, for drought, NDMO was really working with him to better, improve, and enhance their work on early warning and early detection on drought.

The findings indicate that the Ministry of Sugar Industry lacks an early warning and action plan for drought. As a result, the Ministry of Sugar Industry relies on Fiji Meteorological Services to forecast and monitor droughts. However, the droughts are not properly captured due to the slow-onset and localised nature of droughts. Once a drought is forecast, the Ministry of Sugar creates awareness and mobilises resources such as provision of water to the affected areas. The findings also suggest that during droughts farmers are discouraged from planting. This is a potentially erosive strategy, as it affects household income and food security. Therefore, collaborating with other Ministries could help formulate an early warning action plan for drought and assist in mobilising much need resources to drought-affected communities.

6.6 Conclusion

The findings indicate that current support and action provided by the Ministry of Sugar Industry are inadequate to address L&D from cyclones and droughts. The current planned adaptation measures are categorised as incremental and systems adaptation with an absence of transformational adaptation measures. The results indicate that there are many opportunities in the sugar industry for social and ecological transformation that could nurture transformational adaptation. Additionally, the current approaches to address L&D is also negligible. Therefore, the L&D, including the NELD and cascading impacts suffered by the sugar industry, could be considered a climate crisis and warrants a case of climate justice.

Chapter 7 Institutional challenges in the Fijian sugar industry to avert, minimise, and address climate change loss and damage

7.1 Introduction

This chapter highlights key challenges faced by the Fijian sugar industry to mobilise resources for disaster risk reduction and climate adaptation to avert, minimise, and address L&D. In doing so, it identifies critical gaps that are needed to overcome to ensure sustainability of the sugar industry. This chapter begins by providing an overview of national climate change policies and plans and their implications for the sugar industry. Section 7.3 discusses the lack of capacity building from regional to local scales. Access to technology and transfer of technology is discussed in Section 7.4. Section 7.5 documents the lack of data for research purposes or the development of L&D tools. Section 7.6 discusses the challenges faced in accessing climate finance or domestic funds to address L&D. Section 7.7 presents the concluding remarks. By doing so, this chapter aims to address research objective four which is to evaluate institutional and policy gaps in Fiji to prevent, prepare, respond and recover from sudden and slow-onset events.

7.2 Climate change and disaster risk reduction policies

The government of Fiji has been very vocal about climate change and DRR issues and has shown great leadership within the international arena, especially through its commitment to the Paris Agreement. At the national level, Fiji has demonstrated leadership in formulating climate change and DRR policies. The formulation of such policies is aimed at driving CCA and DRR, increasing the resilience of the country and mobilising resources in an effective and sustainable manner. The section below reviews Fiji's national key policies and plans such as the National Climate Change Policy 2018-2030 (NCCP) and the National Disaster Risk Reduction Policy 2018-2030 (NDRRP).

7.2.1 Fiji's National Climate Change Policy 2018-2030 (NCCP)

In response to international climate change commitments, Fiji's NCCP is a key policy document that integrates goals of resilient development with sustainable well-being. The integrated policy vision promotes "a resilient and prosperous Fiji, in which the well-being of current and future generations is supported and protected by a socially inclusive, equitable, environmentally, and net-zero emission economy" (Ministry of Economy 2019, p. 5). The Fijian government recognises that without urgent climate action, Fiji will face irreversible climate impacts and L&D. The NCCP has identified seven policy objectives which includes:

i. National risk governance
ii. Leadership and global climate action
iii. Climate change adaptation and resilient development
iv. Climate change mitigation and resilient development
v. National capacity development
vi. Sustainable financing
vii. Private sector transition and engagement.

Under policy objective Leadership and Global Climate Action (objective 2.3), the NCCP recognises the urgent need to "operationalise the Warsaw International Mechanism for loss and damage" (Ministry of Economy 2019, p. 54). The outcome of this objective is to improve the national ability to address and reduce L&D. In association, policy objectives 6.1 and 6.2 oversee the firm commitment to sustainable finance and resource mobilisation through domestically and internationally driven climate finance for transformative measures. Other areas in the NCCP to enhance L&D support and action include integrated early warning systems, emergency preparedness, comprehensive risk assessment, and risk insurance. Therefore, the NCCP provides a strong mandate to achieve outcomes of the Paris Agreement and L&D within the global positions.

The NCCP aims to build upon existing policies and frameworks such as the National Disaster Risk Reduction Policy 2018-2030 and Fiji's 5-Year and 20-Year National Development Plan, and foster stakeholder collaboration to discuss new and innovative solutions, effective resource mobilisation, and provide much-needed targeted support to those that suffer from climate change L&D.

To assist with the implementation of the NCCP objectives, at the national level, the Fijian Climate Change and International Cooperation Division plays a critical role in coordinating and implementation of NCCP objectives. At the community level, local government and district offices play a crucial role in delivering and achieving the NCCP objectives (Ministry of Economy 2019). Since the launch of the NCCP, the government of Fiji has signalled that every ministry should mainstream the NCCP into its policies, plans, and budgetary processes to drive climate action and build national resilience. One of the key priority areas in the NCCP is the agriculture sector. However, the Ministry of Sugar Industry is yet to develop climate change policies and mainstream NCCP into their plans (further discussed in Section 7.2.3)

7.2.2 National Disaster Risk Reduction Policy 2018-2030 (NDRRP)

To manage and to coordinate disaster responses, the Fijian government has implemented relevant institutional structures and policies such as NDRRP 2018-2030, Natural Disaster Management Act 1998, and Fiji National Disaster Management Plan 1995. The recently launched NDRRP is aligned with the Natural Disaster Management Act 1998 which governs DRR in Fiji and aims to achieve poverty alleviation and sustainable development (The Government of Fiji 2018).

The NDRRP is also constructively aligned to global frameworks such as the Sendai Framework for Disaster Risk Reduction 2015-2030, Paris Agreement on Climate Change 2015, and the Sustainable Development Agenda 2015-2030. The government of Fiji, through its NDRRP, aims to take proactive measures to reduce DRR and ensure that the indicators of the Sendai Framework are achieved by 2030. Fiji's government is also committed to achieving its sustainable development goals by mainstreaming DRR in respective sectors, addressing exposure to climate change and vulnerabilities of the poor (The Government of Fiji 2018).

The policy objective of NDRRP is to "enable Fiji to deliver on its priority of preventing new disaster risks and reducing existing disaster risks in line with relevant regional and global frameworks" (The Government of Fiji 2018, p. 1). The NDRRP is a key document that

identifies DRR as a top priority for Fiji. The policy is governed by eight guiding principles. In compliance with the eight guiding principles, the NDRRP has identified seven policy strategies: mainstreaming DRR, disaster risk governance, financing and investing, preparedness, emergency response, recovery and reconstruction, and knowledge and information. The NDRRP also recognises the importance of risk evaluation and assessment, capacity building to manage DRR, use of disaster risk information and early warning systems, and collaboration with stakeholders. Implementation of these measures can also help to avert, minimise, and address L&D.

The NDRRP has identified a total of 122 actionable items. Some of the action items for the agricultural sector include:

i. The need to strengthen and improve land-use patterns
ii. Protection of livelihood by arranging seed stock and productive assets for farmers after disasters
iii. Sustainable use and management of ecosystems
iv. Strengthen disaster recovery and reconstruction subsidy programme
v. Establishment of climate index-based insurance programme
vi. Collection, evaluation, and sharing of disaster information.

These actionable items are supposed to be mainstreamed into the Ministry of Sugar Industry's policies, plans, budgets, and programmes. However, the findings reveal that the Ministry of Sugar Industry is yet to do so (further discussed in Section 7.2.3). Implementation of these actions at the local and national level build on existing disaster risk management practices and focus on reducing risks from sudden events and slow-onset events, as well as averting, minimising, and addressing L&D. Policy monitoring and review will also be conducted during different phases of the NDRRP.

7.2.3 Sugar industry policy

The sugar industry has formulated the Sugar Cane Growers Fund Act, the Sugar Cane Industry Act 1984, the Sugar Research Institute of Fiji Act 2005, and the Master Award (Ministry of Sugar Industry 2021b). These policies aim to improve cane productivity and mill efficiency, with no explicit consideration of climate change and DRR issues.

Currently, the two major policies in the Ministry of Sugar Industry include the Sugar Industry Act 1984 and the Master Award. The Sugar Industry Act 1984 provides a legislative framework which defines the roles and relationships between various stakeholders. The main objectives of the Sugar Industry Act 1984 are provided below:

a) to establish the Tribunal, the Council, and the Mill Area Committee as institutions of the Industry;
b) to promote the efficiency and the development of the industry;
c) to coordinate the activities of all sectors of the Industry and to promote goodwill and harmony between them;
d) to prescribe standard provisions governing the mutual rights and obligations of the Corporation and the growers, and to provide for the keeping of an official register of the growers;

e) to encourage and provide the means for conciliation with a view to the prevention and settlement of all disputes within the industry by amicable agreement;
f) to provide means for preventing and settling disputes within the Industry which are not resolved by amicable agreement with the maximum of expedition and the minimum of legal form and technicality.

(The Government of Fiji 2019a).

Additionally, the Master Award governs the relationship between the growers and the miller (Reddy 2003). This Award overlooks matters related to sugarcane planting, harvesting, sale and delivery, manufacturing of by-products, and establishment of sugarcane harvesting gangs (The Government of Fiji 2019b).

As noted earlier, these policies aim to achieve higher mill efficiency and maximise production. Despite the Fijian government's request to mainstream climate change and DRR issues into each sector, the Ministry of Sugar Industry has not mainstreamed climate change and DRR policies into its industry policies or developed a climate change industry policy. The relative inaction and the lack of mainstreaming of climate change and DRR policies is an example of lack of adaptive governance. Adaptive governance is necessary to incorporate new information and changing climatic conditions because "*considering the fact that the impacts of climate change keep on increasing, the concern for loss and damage also increases*" (Stakeholder 7). Currently, the sugar industry's climate change policy is "*in draft stage [….] We have to see a number of things that we have to incorporate. It is something new for us and so we are working on those finer details*" (Stakeholder 11).

While addressing the challenges of climate change is a priority for the sugar industry, there are many reasons why there is absence of mainstreaming climate change and DRR issues in the sugar industry's policy. According to one stakeholder, "*There is no magic bullet. Unfortunately, it is a lot of hard work*" (Stakeholder 20). In addition, the Ministry of Sugar industry "*lacks expertise*" and "*requires higher level of training*" for mainstreaming of climate change issues (Stakeholders 16 and 11). Due to the lack of alignment to national policies and absence of climate change policies at the Ministerial level, "*the policies are not filtering down*" and "*there are no policies at the provincial level, district level, village level, and the community level*" (Stakeholders 18 and 10). As a result, it becomes difficult to reduce SES vulnerability, minimise climate impacts, and address L&D. As explained by Stakeholder 4, "*For Winston, the country was not prepared - in terms of legislation, in terms of capacity, and coordination. We did not have that.*"

Unsupportive legislations allow SES to continue on its current pathway, making the sugar industry more vulnerable to current and future climatic risks. Consequently, unsupportive legislations and lack of adaptive governance or rigid governance structures has resulted in many institutional barriers to address climate change impacts and L&D in the sugar industry. To begin with, lack of mainstreaming of climate change and DRR issues at the ministry level has resulted in poor inclusion of climate change issues into research and development priorities. Stakeholder 11 stated:

> Climate change has to be added to our policies that can give rise to preparing strategies that will ensure climate resilience in all facets of research and

> development. Systems and processes can then be developed with key result areas for addressing climate change.

Additionally, since the sugar industry lacks a climate change industry policy, there are no disaster response plans or standard operating procedures (SOP) to inform the roles of respective stakeholders. Stakeholder 10 questioned, "*During a disaster, if there is no response plan, how will we respond to a disaster?*" Due to lack of disaster response plans and SOP, "*a lot of governments do not have the institutional preparedness*" to effectively respond to disasters and mobilise much-needed resources in the disaster-affected areas (Stakeholder 5). Supporting this claim, Stakeholder 16 stated:

> We don't have an SOP and we don't have a disaster recovery plan. If we have all these plans, we will know [how to respond] and it is very efficient in terms of our decision making and resource mobilising.

Likewise, due to lack of policies, it has become difficult for the sugar industry to seek financial assistance from development partners. As Stakeholder 19 noted, "*It will be a way to leverage finances [from development partners] to finance certain projects.*" Due to the lack of policies and institutional arrangements, donors are hesitant to provide assistance, including finance and technical support, directly to the sugar industry. Stakeholder 11 explained, "*Since we don't have [policies and plans] and most of the development partners what to see 'what is your plan?' So, if we don't have this then we lose out on [support and finance]*." Providing further explanation, Stakeholder 16 stated:

> The sugar industry needs to develop policies and that is when we can influence our development partners that climate change is a priority for the sugar sector. Then we can seek funding from there. But at the moment, since we don't have policies or plans in place, it is very difficult to go, negotiate, and approach them. So, we need to have this in place.

More crucially, lack of industry policy on climate change and DRR has resulted in lack of climate change indicators in the sugar industry. As a result, it becomes difficult to measure the industry's progress in addressing climate change issues. Stakeholder 12 questioned, "*What have we achieved and are we in a position to know our status? Can we measure and track our performance?*" Climate change indicators in the sugar industry would not only measure performance but also measure L&D by identifying "*indicators of crops and crop types and the area of impact, the spacing, and the farm equipment impacted*" (Stakeholder 9).

The absence of climate change and DRR policies in the sugar industry has also been identified by external auditors and reported as a key finding of the audit reports. Stakeholder 16 highlighted:

> Actually, our auditors have written in their management letter that we don't have [policies] and they have actually identified this. We have to really do something because of course, this will show the public that the sugar industry does not have all these things. We need to pull up our socks and get our business done.

While at the national level, the government of Fiji has implemented NCCP and NDRRP, the Ministry of Sugar Industry is yet to develop a climate change industry policy. Moreover,

climate change issues have not been mainstreamed in pre-existing policies. The inability to frame climate change and DRR as an urgent issue undermines the sustainability of the sugar industry. Currently, the pre-existing policies are centred around mill efficiency and maximising production with no consideration of climate change. The results indicate that unsupportive legislation and rigid governance structures in the sugar industry are seen to undermine donor assistance and support, research and development, and the ability to mobilise adequate resources. Unsupportive legislation and rigid governance structures reduce flexibility, the ability to adapt to changing conditions, and increases the risk of collapse in SES (Pelling & Manuel-Navarrete 2011).

7.3 Capacity building

Capacity constraints are a sad reality in PICs. Many countries are struggling to build capacity at the national and local levels to address climate change issues (Shakya et al. 2018). At the national level, human resource capacity and human resource availability remain a fundamental challenge for addressing climate change issues, including climate change L&D. Lack of capacity is also evident in the sugar industry. To begin with, the Ministry of Sugar Industry only has sixteen staff and lacks expertise to implement climate change and disaster-related policies.

> In our Ministry, we have only sixteen staff. We are two directors. We have two drivers, so exclude the drivers then we are left with twelve. Then you minus the HR and three accountants [....] We do not have any [climate change] experts in the industry (Stakeholder 16).

The lack of climate change expertise in the sugar industry could be one reason inadequate adaptation measures are being implemented. For instance, the Ministry of Sugar Industry is implementing incremental adaptation measures to minimise climate change impacts and L&D. Implementation of incremental adaptation under current climatic conditions is inadequate to address SES vulnerability resulting in severe L&D (as discussed in Chapters 5 and 6).

It is evident that capacity constraints are evident at the Ministry level to address climate change issues. The challenge of capacity constraint is further exacerbated owing to lack of technical capacity and limited staff in the Sugar Research Institute of Fiji (SRIF) which is a key stakeholder of the Ministry of Sugar Industry. Evidently, limited human resource capacity and human resource availability in the Ministry of Sugar Industry has demonstrated constraints for continuous SES adaptation which are discussed below.

To begin with, due to lack of capacity, SRIF is unable to submit research proposals and secure future projects. This questions the effectiveness of climate change research and SES adaptation measures implemented by the Ministry of Sugar Industry and SRIF. As mentioned by Stakeholder 16:

> The main institute that can submit proposal is the Sugar Research but they also don’t have the capacity. I have been asking for so many years and so many months and they have not been able to provide. So, we don’t have the technical capacity.

Secondly, another constraint for continuous SES adaptation is "*limited resources such as limited staff*" and limited number of extension officers in SRIF (Stakeholder 25). Given that sugarcane farming is done by a huge number of farmers, "*there are few extension officers for so many farmers*" (Stakeholder 25). Hence, the current support and outreach provided by SRIF to the sugarcane farmers is very limited. Stakeholder 25 further explained, "*So, in Ba station, we only have two staff here and others are workers such casual workers. So, the technical staff to farmer ratio is quite huge*."

Due to limited staff, farmer outreach is very poor which impedes critical climate change adaptation measures at the community level. Additionally, lack of extension officer engagement with farmers constraints farmers' adaptive capacity to reduce SES vulnerability and implementation of climate change adaptation resulting in severe climate change impacts and L&D (as documented in Chapters 4 and 5). Stakeholder 25 clarified the reason for lack of engagement with farmers.

> The farm advisory was very active and very effective in the 1990's and late 90's. Then, for the last few years, these extension people were only doing the administrative work, in terms of fertiliser delivery, rice and sugar delivery, getting all the paperwork done, and so they were not able to leave the office and go out. So, we are understaffed, have limited resources, and outreach is slow (Stakeholder 25).

Another factor that restricts the sugar industry's capacity to address climate change issues is the lack of climate change training. Under changing climatic conditions, there is a need to go beyond current capacity and "*strengthen our capacity to address climate change issues*" (Stakeholder 12). Many stakeholders agreed it is imperative to provide adequate training on climate change issues and to "*strengthen research and advisory capacity because [extension officers] are having the contact with farmers on the ground*" (Stakeholder 9). Inadequate training and inadequate understanding of climate change issues exacerbates climate change vulnerability and limits implementation of climate adaptation measures because "*not having a good understanding of climate in relation to crop, soil, and what are the adaptation and mitigation measures, [the extension officers] will be just plainly talking without any depth*" (Stakeholder 12).

Due to inadequate understanding of climate change issues at the community level, the extension officers "*are still struggling to advise farmers*" (Stakeholder 20). In agreement, Stakeholder 18 said, "*The challenge is on our staff and Ministry on how they can better explain to our farmers the changes that are happening. If it is in i-Taukei or Hindi language, then that is the best medium to present this*."

Apart from adequate training, formal education in climate change is also crucial for formulating policies, disaster response plans, and addressing climate change issues. However, many stakeholders, particularly the extension officers, "*have not gone through formal training. It is just like on-going short training and short courses, and they are getting more information through workshops*" (Stakeholder 16). Stakeholder 9 agreed with this, explaining that there are no agro-meteorology courses in Fiji. This also makes the extension officers inexperienced and unequipped with climate change and disaster risk reduction knowledge.

> None of these universities have agro-meteorology course. So, [the extension officers] do not have the climate change lens or disaster risk reduction lens. So, how can you let someone with no disaster risk reduction and no climate change lens in the capacity skill set do the recovery plans for the sector? Because, after the disaster strikes the agriculture department leads. So, I think the government should work with the institutions to develop agro-meteorology courses. Then, equip the extension officers, the research officers, and the policymakers in the agricultural department (Stakeholder 9).

The results indicate that lack of capacity in the Ministry of Sugar Industry exacerbates SES vulnerability and limits climate adaptation. Lack of climate change expertise, limited human resources, and lack of understanding and knowledge of climate change issues constrain adaptive capacity of the sugar industry and questions the effectiveness of adaptation measures in the sugar industry. Additionally, the lack of community outreach and lack of advisory capacity further exacerbates SES vulnerability to climate change.

7.4 Access to technology

The technology mechanism under the UNFCCC is mandated to provide enhanced action for technology development and transfer for both adaptation and mitigation (Bowman & Minas 2019). The importance and relevance of technology for improving resilience to climate change has also been highlighted by Article 10.1 of the Paris Agreement. Article 10.1 states, "Parties share a long-term vision on the importance of fully realising technology development and transfer to improve resilience to climate change and reduce greenhouse gas emissions" (UNFCCC 2015, p. 14). This results section focuses on transfer of technology challenges from the institutional to the community level.

7.4.1 Fiji's Technology Needs Assessment (TNA)

The TNA identifies and analyses technological needs for climate adaptation and mitigation at the national and sub-national levels. Fiji's TNA for mitigation aims to assist with the implementation of UNFCCC's Paris Agreement, Fiji's Nationally Determined Contributions (NDC), and National Adaptation Plan (NAP). Currently, under the TNA mitigation report, energy sector (off-grid rural electrification) and transport sector (domestic maritime transportation) are prioritised (Ministry of Economy 2020a).

Fiji's TNA adaptation report identifies Fiji's agricultural sector, including sugar industry vulnerable to climatic events such as intense rainfall, extreme temperatures, flooding, drought, and rising sea levels. The challenges for agricultural technology transfer highlighted by the TNA includes slow technology mobilisation, and inadequate knowledge transfer as barriers to addressing climate vulnerability. Consequently, Fiji's TNA adaptation aims to bridge these gaps and has identified technological needs for the agriculture sector.

The technology options for resilient and sustainable agriculture recommended by TNA include drip irrigation, integrated pest management, agro-forestry, integrated nutrient management, new and improved varieties, and climate index insurance. From these technologies, the top three priority technologies for agricultural adaptation identified by TNA include agro-forestry, integrated nutrient management, and improved crop varieties (Ministry of Economy 2020b).

Of greater concern is that the top three priority technologies for agricultural adaptation can be categorised as incremental adaptation and systems adaptation measures. While incremental and systems adaptation provide some benefits under an increased degree of climate change, these adaptation measures do not address the underlying root causes of SES vulnerability (Rickards & Howden 2012). At the national level, the TNA has failed to identify agricultural transformational adaptation measures that would address underlying causes of SES vulnerability, minimise L&D, and improve social and ecological conditions.

7.4.2 Access to technology and technology transfer

At the national level, Fiji's NCCP objective 5.2 acknowledges the need for technology transfer for adaptation, mitigation, and risk reduction activities. Objective 5.2 recognises the need "To invest strategically in human and technological capacity building for climate resilient development" (Ministry of Economy 2019, p. 67). Fiji's National Adaptation Plan further emphasises the use of technology for adaptation purposes but also identifies lack of technology as a barrier to adaptation (Government of the Republic of Fiji 2018). This section will focus on agricultural adaptation technologies such as improved crop varieties and agro-forestry as identified by Fiji's TNA for adaptation.

Although technology transfer remains crucial, technology adoption is not straightforward and depends on development, dissemination, and application at the farm level (OECD 2001). The interviews with the majority of stakeholders in the sugar industry highlighted lack of technical and infrastructural support to address the technological needs of the sugar industry. Highlighting concerns and being acutely aware of these challenges, Stakeholders 15 explained:

> Institutional gaps still do exist for us in times of catastrophic climatic crisis such as technical expertise, climate specialists, drip irrigation specialists, including relevant technological resources to detect early warning systems. But internally, the nation lacks sufficient technical expertise, human resources, and financial capacity to fully implement protective measures.

van den Homberg & McQuistan (2019) suggested that innovative technologies are necessary to unlock adaptation potential, overcome adaptation limits, and address L&D. The institutional gaps mentioned by Stakeholder 15 in the sugar industry increases the vulnerability and exposure of sugarcane communities to climate change impacts and residual L&D. This systemic failure presents a legitimate concern to address the impacts of climate change and L&D. As noted by Stakeholder 24, "*Currently, our resources are limited and due to COVID there has been delays*."

Under changing climatic conditions if no technical advancements are made, the technological deficit in the sugar industry will further widen. As mentioned by Stakeholder 4, "*For us, in terms of infrastructure and the big types of technology the other countries are using - it will take time*." Further adding to the challenge is the cost of technology and since Fiji has a small national budget, the government is unable to afford, access, and develop innovative technology such as an early warning system for droughts. As noted by Stakeholder 24, "*These are quite expensive instruments and so having finance for these technological advancements is another challenge*."

Given the current challenges for accessing technology for climate adaptation purposes, SRIF, without any option has to continue with farm activities and technology transfer which are within their capacity. As explained by Stakeholder 14:

> So, for the past few years, we are just rolling with the things that are already being provided to growers [sugarcane farmers]. I don't think SRIF is providing any innovate technologies to grower.

At SRIF, the research staff continues to breed climate resilient sugarcane varieties. Fiji's TNA report also emphasised breeding of improved crop cultivars as a top adaptation technology (Ministry of Economy 2020b). However, adaptation technology such as new climate resilient varieties presents many challenges for SES adaptation. To begin with, even though systems adaptation could provide profound benefits under changing climate, it is questionable if new resilient varieties have the capacity to withstand intense cyclones. As stated by Stakeholder 16 in the previous chapter, "*I do not think that we can create some variety that can withstand category 5 cyclones*."

Secondly, as discussed in Chapter 6, the uptake of new climate resilient varieties is limited due to the current sugarcane weight payment system. Farmers prefer to plant Mana variety because it weighs more. The current weight payment system provides no encouragement to adopt climate resistant varieties. Therefore, breeding new climate resilient sugarcane varieties could be seen as "a waste of time and money" if farmers are unwilling to adopt the new varieties (Stakeholder 16).

Additionally, the transfer of climate resilient varieties remains a challenge because these technological transfers are not socially well accepted by the sugarcane communities. Since the industry comprises mainly older farmers, "*these are ageing farmers think they seem to know everything. So, this is very hard to change*" (Stakeholder 11). The sugarcane farmers are reluctant to pursue the uptake of new varieties as they lack experience with the new varieties. As stated by Stakeholder 12, "*Sometimes, when we are introducing a new technology, or we are giving a new innovation, it is very hard for farmers to adopt because of the fear of moving into something new*."

The third limiting feature of the breeding programme is limited farmer outreach. Due to limited farmer outreach, new technologies do not reach vulnerable communities.

> We do have a component called technology transfer. So, we do go to farmers but probably not to the extent as FSC extension officers. We are not able to have that kind of outreach. So, what we try to do is to merge as many farmers as possible. So, if farmers come to us, we encourage them to tell other farmers. So, we do this kind of technology transfer (Stakeholder 25).

The TNA adaptation report also emphasises the value of agro-forestry application. Yet, interestingly, one observation made in the field was that none of the households practiced agro-forestry. There were trees present around the farm but these trees have been there for many generations and were not planted by farmers. These trees do help to prevent soil erosion. Previously, the Fijian sugar industry had a reforestation project funded by the EU. Trees and plants were provided to farmers as part of sustainable land management practices to help to deal with soil erosion and climate change. However, communities visited as part of

this research did not mention the reforestation project. The lack of technology transfer in this case is an indication that the technologies prioritised in the TNA adaptation report may not be reaching the vulnerable communities and is one area that is clearly overlooked.

The results from this section have indicated that Fiji's TNA for agricultural adaptation has identified incremental and systems adaptation as top adaptation priorities. At the national level, the TNA has failed to identify transformational agricultural adaptation measures that would assist in addressing SES vulnerability, minimise L&D, and improve social and ecological conditions. At the sectoral level, the Ministry of Sugar Industry lacks technical and infrastructural support for addressing current climate change impacts and L&D. Consequently, the Ministry of Sugar Industry and key stakeholders are currently continuing with technology transfer that is within their capacity such as breeding of climate resilient varieties. However, climate resilient varieties are not socially accepted at the community level due to the weight payment system. Additionally, another agricultural adaptation technology prioritised by Fiji's TNA is agro-forestry. The result results indicate that the importance and practice of agro-forestry was absent from Barotu and Toko settlements – an indication that technologies prioritised in the TNA adaptation report and the targeted support may not be reaching the vulnerable communities.

7.5 Lack of data

For many countries, the lack of access to appropriate L&D data is a concerning challenge in addressing L&D (Thomas & Benjamin 2018a). Gathering information on demography, exposure, vulnerability, and adaptation measures, as well as the direct experiences of L&D is necessary to address L&D. A recent report by UNDP (2017) highlighted that due to lack of data, PICs face various challenges in addressing the adverse impacts of climate change. Sharing the findings of this report, Stakeholder 2 expressed concerns:

> You can see so many projects happening in the region but we still face a problem with data. This is also an issue - lack of data. Even in the SDGs report, that is what UNDP reported. We in the region have lack of data. So, the question is 'what have they been doing here?' There is always the problem of data, data, data.

At the sectorial level, stakeholders from the Ministry of Sugar industry agreed that "*lack of data and good data set is an obstacle in doing good research*" (Stakeholder 16). While the Ministry of Sugar Industry recognises the importance of data, several reasons have been identified for lack of access to data. Firstly, due to lack of climate change expertise, climate change adaptation and mitigation data are not adequately captured by the Ministry of Sugar Industry. As mentioned by Stakeholder 16:

> For example, the Ministry of Economy was asking what percentage of emissions are being discharged from the [sugar] mill and when I asked the [sugar industry employees] they were lost. Everyone was lost. We had never captured this kind of information.

Secondly, another reason for lack of access to data is that it is mostly collected in isolation with very little standardisation. While each sector remains committed to data collection, "*all Ministries are doing their own assessments*" (Stakeholder 4). The reason for each Ministry collecting its own data and its inability to share these data is articulated by Stakeholder 4.

> We are still working on sharing the data. We have the Fiji Bureau of Statistics that collects data but for most Ministries that data is not tailor-made to our needs and sometimes information is not fully captured. So, each Ministry just goes out and collects its own data.

Yet, standardisation of data and a "*standard format recording assessment*" is important for analysis, research, and comparison across themes and sectors (Stakeholder 17). Moreover, due to lack of collaborative partnerships between different sectors and clusters, it becomes difficult to access this data. Stakeholder 17 added, "*At the moment, all the data and information that are available are still sitting with each cluster*." As stated by Stakeholder 4:

> It is very hard for us at the Ministry to access that data. You have to go through a number of processes. There is a lot of signing of MoE, MoU's and in this process each Ministry is unwilling to give data for confidentiality and security purposes.

The lack of data standardisation and unwillingness to share data has presented obstacles in addressing climate change vulnerability. According to Stakeholder 4, "*We see the impacts of these natural disasters are still there and the vulnerability too is still there*." Additionally, lack of standardised data has resulted in lack of L&D tools and methodologies. Currently, disaster assessment data is available through post-disaster reports such as PDNA reports (Esler 2016). Many stakeholders in the sugar industry have used PDNA report as an assessment of climate change L&D. However, using PDNA report as an indication for climate change L&D is inaccurate. The PDNA captures data only from a particular event which is known as damage and loss data. Therefore, the PDNA report is not formulated to measure the climate change L&D. L&D data collection has to be continuous and collected from several sudden and slow-onset events. Yet, many ministries use PDNA reports to provide a snapshot of losses that occurred during a cyclone. Stakeholder 9 clarified at length:

> Yes, well the clusters have templates. Those templates are both like quantitative tools and little bit of qualitative. It looks at trying to determine the percentages of damages to crops etc. Then they will determine and help to establish the cost of loss. So, it is more like the replaceable cost. There are some tools like that especially for cyclones. For droughts it is very hard. We had tried to do some drought impact for drought of 2015 but it was very hard. So, there are tools already developed for post disaster assessments but that is the thing because those are the tools designed to measure the damage and loss - the disaster aspect of things. They are not formulated to measure the climate change aspects. It is not categorised as economic and non-economic loss because the climate change loss is categorised according to that. But for the disaster, it is more of planning the recovery - that is the main purpose. It is to know the percentage of loss and the percentages of damages and how much food is available and the capacity on the ground so that people can plan the actions for recovery. But if we look at it from the loss and damage and the climate change perspective, we have to look a little bit on the long-term. So, if we do the assessment then it is not just the assessment of one event, it is an assessment of events to see how to build the resilience and how to reduce the loss and damage in the long run.

Since Fiji lacks tools to capture climate change L&D data, urgent and meaningful adaptation measures cannot be implemented. As a result, collection of standardised data across Ministries and L&D data needs to be prioritised for urgent climate action. Stakeholder 19 mentioned, "*So, I think for our countries, we have to prioritise collecting data on climate change loss and damage*." The prioritisation of climate change L&D data can assist in "*developing loss and damage tools*" and "*scale up action for adaptation*" (Stakeholders 9 and 19). Another challenge is the lack of methodologies to estimate and capture NELD. As stated by Stakeholder 8, "*We need more data and ground-breaking research to actually look into [non-economic loss and damage] and for PICs to be compensated for what they have not done.*" Accentuating the importance of L&D data collection, Stakeholder 9 explained at length:

> The process where we start to collect some form of documentation for loss and damage is also top-down from UNESCO. I think for our university, the University of the South Pacific, we are small island state university, we are Pacific university, we should prioritise loss and damage research covering everything - data collection, financing, and resilience. This should be part of our framework because that is our strength. Even US universities do not want to do it. Then we should do it. There are other universities in the UK as well. So, if there is a multi-partnership between our university and other universities to develop these tools, collect, and document loss and damage data. So, it has to come from the top. Then make it like a project for 3-5 years, projects to develop methods and things like that. So, this climate risk management, the loss and damage project, GIZ is a global project, and it has been going on for 3 or 4 years. They tried to build capacity for people to integrate climate risk management in government decision and things like that but one indirect outcome of that is documenting loss and damage. But we still have not got suitable methodologies. Even Koko Warner and those people, we had a lot of discussions but because they got caught up in the high-level negotiations and they spend most of their time trying to address this high level but not developing tools to collect the data.

The results from this section have indicated that lack of data has been an obstacle for research and development in the sugar industry. While data collection is prioritised, attention also needs to be focused on vigorous and standardised collection of data and sharing of data between different Ministries. Lack of standardisation and sharing of data has presented obstacles to understand SES dynamics and drivers of change and to address climate change vulnerability. In addition, the lack of standardised data has resulted in lack of L&D tools and methodologies and barrier for implementing adequate adaptation measures. Therefore, collection of standardised data and sharing of data has to be prioritised for urgent climate action and to address climate change L&D.

7.6 Access to climate finance

Climate finance, particularly L&D finance, has been a contentious issue at the global platform. UNFCCC's WIM has been criticised for focusing on the first two mandates and neglecting the third mandate which focuses on enhancing action and support, including L&D finance (Gewirtzman et al. 2018). This section discusses challenges faced by the government

of Fiji in accessing climate funds and challenges encountered by the Ministry of Sugar Industry to access national funds.

7.6.1 Accessing Green Climate Fund

Climate finance refers to various sources of finance such as local, national, and transnational finance usually drawn from public, private, and alternative sources that seek to support mitigation and adaptation measures (UNFCCC 2021b). According to UNFCCC, "The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations (UNFCCC 1992, p. 8)."

However, accessing climate finance, particularly L&D finance, has been presented with many challenges. To begin with, many scholars have argued that climate change L&D is a matter of climate justice (Huggel et al. 2015; Thomas et al. 2020; Wallimann-Helmer 2015; Zellentin 2015). Advocates of climate justice have argued that developed countries hold moral and legal obligations to assist developing countries in addressing the issue of L&D (Burkett 2016; Kreienkamp and Vanhala 2017). Yet, historical responsibility claims for climate change impacts have been contentious (Adger and Barnett 2005; Burkett 2016; Harrington and Otto 2019; Huggel et al. 2016). Supporting this claim, Stakeholder 16 said, "*So, it is a historical responsibility to address this issue because the developed countries have caused it and they have benefitted from it*." Stakeholder 6 also added:

> For me, climate change [loss and damage] is a justice issue and I believe that those that are responsible for this problem should be paying to address the problem. And I think to address loss and damage, money should be coming from developed countries and major polluters.

Further expanding on this, Stakeholder 2 argued:

> You have suffered a loss and need to be compensated. That is one of the greatest challenges why developed countries do not want to provide finance and put it in black or white – 'oh, this is loss and damage finance' because this is an admission of responsibilities. They do not want to admit it. To them, this is an obligation whereas if you look at the agreement, especially the 1992 [UNFCCC] Convention it says that developed countries shall provide - it is mandatory for them to provide. So, we can argue that there is a responsibility for them to provide. The Paris Agreement watered down that particular section which states that it is the responsibility of the developed countries to provide support for climate change initiatives even loss and damage.

Secondly, the greater polluters or developed countries have not been able to provide sufficient climate finance for climate change L&D (De Marez et al. 2022; Pauw et al. 2018). Developed countries had pledged to jointly mobilise US$100 billion new and additional funds annually by 2020. These funds would primarily be allocated for climate change priorities in all sectors of developing countries which will flow through the GCF (Chen, Suzuki & Lackner 2016; Cui & Huang 2018; Kissinger et al. 2019). However, the GCF has not progressed smoothly and it remains clear that the 2020 target was not achieved (Cui & Huang 2018). Notably, developed countries have consistently pushed back on the issue of L&D finance and also

avoided committing themselves to US$100 billion per year (Benjamin, Thomas & Haynes 2018; Cui & Huang 2018). As critiqued by Stakeholder 6, "*But already the GCF is not reaching or is not pulling in what it needs to as promised by developed countries – US$100 billion per year by 2020. And they have not done that - not even close*."

Another challenge for L&D finance is the lack of clear mandate on how L&D finance will be allocated under the GCF. The GCF website clearly states that it supports work in both climate mitigation and adaptation with no mention of L&D (GCF 2021). Many stakeholders argued that placing L&D under the GCF would create fund allocation challenges and affect current financing of mitigation and adaptation. Stakeholder 2 emphasised, "*If you look at how climate finance is structured in GCF, it only talks about mitigation finance and adaptation finance*." Stakeholders 2 and 6 questioned the allocation of L&D finance under the GCF, raising concerns that L&D finance could be lumped together with adaptation finance.

> The GCF is to provide adaptation finance and mitigation finance. So, if you were to put L&D finance, you are further dividing the cake. You are not increasing the size of the cake and there is a possibility that you are going to cut into the share of the adaptation finance. So, my take is that it needs to be a separate mechanism altogether. It needs to be new and additional to what is already being provided be it mitigation finance or adaptation finance (Stakeholder 2).

> The potential problem is that loss and damage finance might be lumped in with adaptation and also the issue of how do you allocate funds? That US$100 billion needs to be separate, and they need to provide new and additional finance for loss and damage. That new and additional finance should be governed separately. So, still within the GCF but the US$100 billion should be 50/50 for mitigation and adaptation and then loss and damage finance should be separate (Stakeholder 6)

Therefore, the question now arises as to how L&D responses can be financed? Will the Parties under the UNFCCC further discuss the modality or how the funds should be delivered? Following the climate finance discussion closely, Stakeholder 2 asserted that determining the modality of the L&D funding is very crucial.

> As to what form it is going to take? How is it going to be delivered? These are issues that we need to start discussing now. That is for me always the weakness of the developing countries. We would rather talk about the source rather than what it should look like and how it should be delivered. This is a technique by the developed countries trying to delay the discussions. They already know how they are going to provide the funding, how they will source it, and the form it should take while we are concentrating on the source rather than what it should look like and how it should be delivered. You know, this is a distraction – 'it should be ok, how do we rise it?' The source should be the last thing that we talk about in-terms of the mechanism that will be used to deliver the finance. We should be talking about the modality. How should it be delivered? How should it be measured? Who can assess it?

While the amount of L&D funding and the modality of L&D remains a controversial issue, stakeholders also agreed that GCF allocation of the funds also need to be revisited. The main

reason behind this is that there are no regional or country targets for fund allocation under GCF which increases competition to access funds among countries (Atteridge & Canales 2017). This is regarded as another challenge in accessing climate finance. As explained by Stakeholder 2, "*You still have to compete, and you have to compete with other big players and big countries that have resources*." Consequently, the amount of climate finance received by the PICs is relatively low compared to the developing countries and is mostly provided on an ad hoc basis (Samuwai & Hills 2019). This disparity further increases marginalisation making PICs more vulnerable to climatic impacts. Highlighting these concerns, Stakeholders 1 and 2 mentioned:

> But if you look at the GCF, the share of the funds coming to the region is just for adaptation and it is still minimal compared to how much money is going to mitigation for other countries - which is huge. I can say that almost 80 percent is going to mitigation and less than 20 percent is coming to the region for adaptation. Only twelve [PICs] countries have access to GCF and [the total amount received] is only $376 million (Stakeholder 1).

> The imbalance between the two [adaptation and mitigation] is so vast. Most of the climate finance goes to mitigation finance as compared to adaptation finance. If you look at the climate policy initiative, the latest report mentioned that the 95:5 percentage ratio (Stakeholder 2).

Additionally, the process of accessing funds from the GCF is a challenge for the PICs as the process is very stringent, complex, and challenging (Samuwai & Hills 2019). Agreeing with this, Stakeholder 1 stated, "*The process of getting into the international facilities, that is, climate finance, it is a nightmare. Simply because the GCF facility is so stringent*." Directly accessing GCF involves a vigorous accreditation process and readiness of the government to receive funds (Oxfam 2016). Due to stringent accreditation process, "*twelve countries in the region have access but no country has access directly*" (Stakeholder 1). Stakeholder 6 further mentioned, "*To access funds from the GCF is quite complicated and so the smaller countries are already experiencing issues with access and so they are constantly calling for simplified access*."

The process of accreditation can be long and tiresome with multiple levels of reforms and redrafting including implementing new procedures and policies to create an enabling environment. Entities seeking accreditation have to be committed to invest time and human resources in learning and meeting these requirements (Hook 2019). So far, only the Cook Islands, Fiji, and the Federated States of Micronesia have been accredited to have direct access to GCF (Samuwai & Hills 2019). Regardless, accreditation does not guarantee access to funds. Noteworthy proposals with project timeline have to be submitted. As stated by Stakeholder 2,

> Accreditation has the stamp that certifies that you have the capacity but it does not mean that you are accredited and you will get the funds.

Consequently, showing competence and development effectiveness through vigorous fiduciary standards and diligent finance ministry are crucial to access and manage funds. As Stakeholder 1 explained:

> If they come and assess and look at your financial arrangement, in Tonga or Fiji and see that your audit is grade C, they will be reluctant and say, 'I do not trust your system or the audit system or the accounting processes until you get an A [grade]'.

Since the PICs have difficulty in accessing funds, other multi-lateral and regional organisations such as the Asian Development Bank and The World Bank have offered to access climate funds on their behalf while charging the PIC nations an administrative fee. A significant portion of the funding is deducted as management fee by the accredited entities accessing funds on PIC's behalf (Atteridge & Canales 2017; Samuwai & Hills 2019). This again leaves a negligible amount for the PICs to address climate impacts. Therefore, the primary aim of directly accessing funds by PICs is to reduce transactional costs and enhance national finance ownership (Hook 2019). As stated by Stakeholder 1:

> Imagine if you want to access through me and if you go through a reception and the reception will charge you, then will take a commission from that - from the money that I am supposed to give you. That is the principle. That is exactly the current situation now. If Tonga or Fiji wants to access these facilities, they have to go through ADB, SPREP, and other organisations and then the money will go through them and then to Fiji. And they will take the commission and the commission is huge - around 20 percent of the fund. It can be more than a million.

The results indicate that climate change L&D and accessing climate finance is a question of climate justice for PICs. Currently, the lack of commitment shown by the developed countries to mobilise L&D finance and the consistent push back on the issue of L&D finance is seen as climate injustice. GCF has been faced with insufficient financing and lack of clear mandate on how L&D finance will be allocated under the GCF. Finally, it is argued that institutional capacity building and accreditation in the PICs needs to be strengthened with vigorous fiduciary standards to access climate finance.

7.6.2 National access to climate finance

This section discusses national access to climate finance and financial support provided by donors and external aid. As discussed below, the results have highlighted several limitations in accessing climate finance as well as drawbacks of financial support provided by donors and external aid. To begin with, the government of Fiji has received accreditation from GCF but has limited access to climate finance. For instance, the Fiji Development Bank has received accreditation from GCF for funded activities that fall within the Environmental and Social Risk Categories (lower risk categories), "*however, being accredited to the GCF does not guarantee that you will be able to access the funds*" (Stakeholder 2). Stakeholder 2 critiqued:

> If you look at the level of accreditation given to Fiji - it took them four years. Fiji had to do a lot of restructure and reforms within the Fiji Development Bank but they can only access $10 million which is the micro-level - the lowest level. And now it begs the question if it was worth it because what can you do with $10 million?

One reason why the government of Fiji is struggling to access climate finance is because "*we just do not have the capacity*" (Stakeholder 1). A recent study by Samuwai & Hills (2019)

also highlighted that accessing finance for PICs has been difficult due to local capacity constraints. Similar constraints are noted in the Ministry of Sugar Industry. Stakeholders 16 shared:

> So, [the sugar industry] really does not have the capacity to write proposals to access those funds easily. But I mean we still have opportunities. But if we establish the climate change unit at least those people can help submit proposal. But it is not very straight forward too. It is also very bureaucratic.

Another challenge faced by the government of Fiji in accessing climate finance is the development of sustainable projects. After receiving accreditation, the national entities are tasked with development and implementation of projects. Stakeholder 19 said, "*The major obstacle is developing the project proposal and that is why we are not able to access that readily and that easily*." In order to access the funds, the projects need a proper timeline and need to demonstrate how resilience would be enhanced and how vulnerable people will benefit from the project (Hook 2019). Accordingly, in-house capacity needs to be built, there needs to be foresight for a suitable project, data availability, and "*monitoring and reporting back*" (Stakeholder 2). Nonetheless, Fiji has failed to develop a suitable project. As criticised by Stakeholder 1:

> But they have not submitted the project under the GCF. These are lessons learnt from us. You rush to submit your accreditation project and to complete it and rush to get your approval. But you failed during the cost of the project to contemplate what will be a bankable project for you to submit? So, you get it and now they are still developing the project. But that is a reflection of the capacity limitation. Not just any project, it has to have a very strong paradigm shift and the element of transformation. Meaning that you have to have a project that will transform you from where you are now to something better and sustainable.

Apart from access to climate finance, external aid has been crucial for the PICs, including Fiji, as a means to supplement government's own expenditure through the national budget process. In the PICs, the majority of financial support is provided through bilateral channels and donor projects with little support from the national budget (Atteridge & Canales 2017). For example, the EU is a major donor for the sugar industry, supplementing their budget for climate-related projects. However, the Ministry of Sugar Industry is often overlooked by donors. Stakeholder 16 disclosed:

> Most of the time, [the sugar industry] misses out especially funding from the development partners. And so that's the issue. These are the challenges and so we are unable to benefit and farmers are also unable to benefit. I mentioned earlier they are always trying to forget us. But it is not deliberate, it is an oversight. There was one forum that I went to, and I found that the UN is funding the Fijian government. In terms of the total funding that comes to the government annually is about $40 million. That's $40 million annually! That is US$40 million but nothing comes to the sugar industry.

Much external aid is also delivered outside the national budget and the government struggles to track this finance or guide it to meet national goals. According to a report by Stockholm

Institute, the vast majority (86 percent) of climate finance is delivered as project-support while only 1 percent is delivered as general budget support (Atteridge & Canales 2017). As a result, there is duplication of work, waste of resources, and it is unclear if the projects meet national priorities. External funds from donors should be geared towards meeting the needs of the vulnerable communities and allocating funds where it is needed the most. As such, better tracking and monitoring systems are crucial to track climate finance and external aids. As clarified by Stakeholder 2:

> If you look at the latest report by the Stockholm institute in relation to climate finance in the Pacific only 1 percent of the external finance that come to the Pacific is delivered as direct support. That means they give finance to the government to programme in their national budget. Most of it are delivered outside and this means that the government does not know what is happening. Which means that the government cannot monitor, and this increases redundancy as well because there is lack of coordination. This brings in duplication of work and short-term projects that is not sustainable.

Stakeholder 2 also questioned the sustainability of these projects.

> Just come, implement and go. How do you ensure that it continues? How do you ensure that it transforms lives? And how do you ensure that the project that you are bringing in even fits the needs of the communities?

The results suggest that there are many challenges in accessing climate finance at the national level. Despite receiving accreditation, the government of Fiji has failed to access climate funds due to lack of institutional capacity. In addition, after receiving accreditation, the Fijian government has been unable to submit sustainable projects due to lack of project foresight, lack of data availability, and lack of monitoring and reporting processes in place. Moreover, other financial support such as external aid is delivered outside the national budget and difficult to track. As a result, there is duplication of projects, and it is unclear if the projects meet national priorities. At the sectoral level, the Ministry of Sugar Industry has also failed to access funds. This is partly because the Ministry of Sugar industry is being overlooked and there is due to lack of expertise for proposal development.

7.6.3 Limited domestic funds

Domestic finance plays a crucial role towards financing climate action. Mobilising internal resources using taxes and non-tax arrangements in a country is crucial in addressing impacts of climate change. However, being a small island nation with limited resources, including limited financial resources, presents an undisputed challenge for the Fijian government to meet its climate objectives and needs to increase the country's resilience. Highlighting concerns of a small national budget, Stakeholder 4 said:

> The first challenge that we can think of is our budget. For us, we have limited budgets. There is a lot of work to do, and it is a matter of proper planning and networking together with our partners. We can rely on our donors to assist us. For us here it is just the budget because if we have the right budget or the amount of budget then there is a lot of activities that we plan but we can only cater for some.

At the national level, during a disaster, the funds allocated under the disaster relief fund is insufficient for post-disaster recovery and rehabilitation work. Limited financial capacity to address climate change impacts leaves the government in a fraught position, as many communities are in immediate need of assistance and with limited budget, the government finds it difficult to respond accordingly. As documented in the preceding chapters, the impact of TC Winston was so severe that huge amounts of international humanitarian assistance and social protection interventions were required (Mansur, Doyle & Ivaschenko 2017). As mentioned by Stakeholder 16:

> TC Winston was very severe. Almost everything was gone. So, we had requested money - funding from the government and there was some money, and it came from the development partners as well for the rehabilitation work.

To scale up domestic financial support, some countries are setting up national financial mechanisms to address L&D (Schäfer, Künzel & Fuhrmann 2019). In Fiji, for example, domestically driven innovative climate finance mechanisms include the Environment and Climate Adaptation Levy (ECAL). This domestic financial initiative could assist Fiji to mitigate the adverse impacts of climate change (Ministry of Economy 2018; Republic of Fiji 2017). ECAL is a tax on prescribed items, services, and income such as tax on imported luxury vehicles, levy on plastic bags, and 10 percent income tax on individual earning of more than FJ$270,000 (Ministry of Economy 2018).

According to the 2019 report compiled by the Ministry of Economy (Government of Fiji 2019), FJ$119.7 million were collected, and 92 percent of the funds have been utilised for adaptation purposes, while 8 percent of the proceeds was allocated to mitigation. The levy funded 46 projects which included disaster relief and response, meteorological services, rural and urban development, agricultural development, sustainable resources development, infrastructure development, energy conservation, and environmental conservation (Ministry of Economy 2018). While innovative domestic finance is being created to bear the cost of climate change impacts, these sources of domestic finance are still inadequate to address climate change vulnerability. Stakeholder 2 expressed concern:

> For example, just look at the roads, look at the number of squatter settlements. It is pathetic, it is really, really pathetic and it is sad too in-terms of the discourse on what is happening at the international level and at the community level. Like I said, the vulnerability at the community level is still there and it is worsening.

Another limitation with domestic finance is the lack of transparency provided by the Fijian government. With only the availability of the ECAL report, there is scepticism on how the money is spent, and where the money is going. Stakeholder 2 scrutinised:

> With the ECAL, they managed to collect the FJ$50 million, and they have reprogrammed it into the budget. This is what they are saying. Yet, we do not really know. Yes, the only accountability that they are showing is the ECAL report. But we do not know whether that is really the ECAL money or was it a donor-funded money. Yes, we do not know.

While the government controls domestic sources of finance such as ECAL and allocates the finances accordingly, it is also important for the government to consider if local communities

and individuals can access these sources of finance. As mentioned in previous chapters, currently the only pre-disaster funds available to farmers are in the form of loans. Poor and vulnerable farmers that are drastically impacted by cyclones and drought are hesitant to take loans in the fear that they will be unable to repay their debts. Farmer's inability to pay-off debts and recover from disasters sets in motion a vicious cycle of poverty that many are unable to escape. Hence, the question is, should innovative finance such as the ECAL be made available to farmers? If yes, then how can farmers access these? As discussed by Stakeholder 1:

> But if you look at farmers, if they want to access, do they have the capacity? Who is going to prepare their submission to access? So those are the issues that they have to consider before designing a product. Is it the big corporation that is going to access or farmer? Because the big corporations have the money and they can access, and farmers are small, and they don't have that capacity. So, that is the question you need to ask the Fiji government. In Samoa, the accessibility, for some people in the community, the government has made an agreement with the civil society for providing the capacity in-terms of assessing the communities in filling the project proposal. I do not know whether that is an effective way but at least they have some sort of a mechanism to help farmers.

At the Ministry level, the Ministry of Sugar Industry also has limited to access national funds. Sugar industry's lack of expertise and lack of focal point for climate change initiatives have been linked to difficulties in writing proposals and accessing national funds for projects. Due to these difficulties, the sugar industry's special request for climate change and disaster management was also not approved. As stated by Stakeholder 16:

> I remember last financial year we requested special funding for climate change and disaster management but we did not get it [....] So, we really need somebody or probably establish a unit to have somebody that could drive this because only an expert can do that.

Moreover, the national annual budget allocated to the sugar industry is limited and does not show evidence of any climate resilience project. Although, the Fijian government 2020-2021 budget of FJ$53.6 million had been allocated to the Ministry of Sugar Industry for a "vibrant and sustainable sugar industry" (The Government of Fiji 2020, p. 229), rather what is being budgeted for includes allocation for "Sugar Development" which includes staff wages, travel and communication, maintenance and operations, purchases of goods and services and operating grants and transfers. Other budget allocations includes capital grants and transfers include Sugarcane Development and Farmers Assistance - FSC ($500,000), Cane Cartage (Penang to Rarawai) - FSC ($3,000,000), Weedicide Subsidy - FSC ($500,000), Cane Access Roads - FSC ($1,000,000), Fertiliser Subsidy - FSC ($15,620,136), New Farmers Assistance ($250,000), Sugar Stabilisation Fund - FSC ($30,000,000) (The Government of Fiji 2020, p. 229). Evidently, there is no fund allocation specifically for developing projects for addressing climate change vulnerability, impacts, and L&D. Due to lack of funds, Stakeholder 16 emphasised that it has become difficult to implement climate change mitigation and adaptation strategies.

> I think I am keeping my fingers crossed that some money could come our way. And it is really about time because government is aggressively promoting climate change. So, we really need to have all this plans in place. We need resources in terms of funding, assistance from the development partners, as well as the government. Other development partners have a lot of funds related to climate change and we need to access that and to implement adaptation and mitigation strategies.

Additionally, under the 2020-2021 budget, SRIF has been allocated FJ$675,000 for research and development purposes, and to provide technical support to farmers (The Government of Fiji 2020). Yet, as mentioned by Stakeholder 25, these funds are limited, and no financial assistance are provided to farmers.

> Certainly, we are funded by the government. So that is 33 percent, one-third by the government, one third by FSC, and one third by Growers Council. But FSC and Growers Council is also funded by the government. So, since we are funded by them, we work on the budget given by them. We do not have any programme where we can go and financially help farmers. But what we do is that we go and advise on the next step which is the technical support. We are not available to provide financial assistance because we are ourselves limited in funding.

While the Ministry of Sugar Industry has not received funds for climate change projects, there are other Ministries have been allocated funds for climate change research. In the 2020-2021 budget estimates, under the Ministry of Economy, there is allocation of annual contribution to UNFCCC ($2152), CommonSensing (95,000), and Aid-in-kind: Developing Climate Disaster Risk Financing Framework and Parametric Insurance (Government of India) ($1,849,032) (The Government of Fiji 2020, p. 33). Likewise, under the Ministry of Rural and Maritime Development and Disaster Management, Disaster Management Services, National Disaster Database and Awareness on DRRP has been allocated $60, 000, while aid-in-kind from NZMAT and JICA amounts to $3,968,815.00. The disaster relief and rehabilitation fund has been allocated $800,000 (The Government of Fiji 2020, p. 85). Even though these Ministries have been allocated funds for climate change research and development, the Ministry of Sugar Industry has minimal financial support to address climate change vulnerability and L&D in sugar industry. This could also be one reason why the Ministry of Sugar Industry is continuing with incremental adaptation measures under increasing climate change impacts resulting in severe L&D (as discussed in Chapter 6).

The results indicate that domestic funds are inadequate to address climate change vulnerability and L&D. Although the Fijian government has introduced innovative national domestic finance such as ECAL to implement climate change adaptation and mitigation projects, evidence suggests that the domestic finance is still inadequate to address climate change vulnerability. Other limitations are also noted with ECAL which includes lack of transparent report and inaccessibility to vulnerable communities. At the Ministry level, while other Ministries are able to secure funds for climate change projects, the Ministry of Sugar Industry lacks climate change expertise and is unable to access domestic funds for climate adaptation and mitigation projects. The lack of funds for climate change initiatives is also clearly evident in the 2020-2021 national budget.

7.7 Conclusion

This chapter has identified major institutional gaps to mobilise resources to avert, minimise, and address L&D in Fiji's Ministry of Sugar Industry. These institutional challenges include unsupportive climate change policies, lack of human resource capacity, limited adaptation technologies, lack of data, and lack of access to finance. At the national level, limited institutional capacity is a major challenge for accessing climate finance. Despite receiving accreditation, the government of Fiji has encountered challenges to secure climate finance. This is partly because the Fijian government has been unable to submit sustainable projects due to lack of project foresight, lack of data availability, and poor fiduciary standards.

At the Ministry level, the Ministry of Sugar Industry lacks climate change expertise. The absence of climate change expertise has been identified as a major challenge for mainstreaming climate change policy into sectoral polices and plans. Primarily due to unsupportive legislations and plans, the Ministry of Sugar Industry is unable to access domestic and donor funds. The inability to access funds undermines widespread support for climate change research and development and the ability to address climate change vulnerability in the sugar industry. Moreover, the lack of funds is an obstacle in implementing innovative technology in the sugar industry. The findings from this research strongly suggests that access to climate change expertise and development of climate change policy is a key driving mechanism for accessing domestic funds, enhancing capacity, and implementing new innovative adaptation technologies.

Overall, it can be argued that in order to facilitate adaptation and mechanisms to address L&D, attention needs to be paid to processes happening at the national, sectoral, and community level. More crucially, more comprehensive social, ecological, economic, and political process need to be recognised within which the system of interest is embedded to address SES vulnerability.

Chapter 8 Discussion and conclusion

8.1 Overview

Climate change L&D research has gained significant attention from the international community (McNamara et al. 2021; Pill 2022). Vulnerable communities continue to suffer disproportionally despite contributing the least to anthropogenic climate change and have the least capacity to respond (De Marez et al. 2022; McCubbin, Smit & Pearce 2015; Monnereau & Abraham 2013). Recent cyclones and droughts in Fiji have caused devastating L&D in the sugar industry (Esler 2016; Feresi et al. 2000; FSC 2016; Terry & Raj 2014). Building on recent climate change L&D research, this research presents a case study of L&D in Fiji's sugar industry. Chapter 1 introduced SES vulnerability of Fiji's sugar industry to cyclones and drought and the resulting L&D in SES. The aim of this study, as highlighted in Chapter 1, was to identify institutional and policy gaps in the understanding of L&D and critically evaluate opportunities for policy, planning, and funding mechanisms for anthropogenic climate change L&D within the sugar industry of Fiji. To achieve the aim of this study, the following research questions were formulated:

1. What conditions make Fiji's sugarcane communities vulnerable to climatic stressors such as sudden events (cyclones) and slow-onset events (drought)?

2. What are the current community-based adaptation strategies in Indo-Fijian sugarcane communities and residual L&D?

3. Are the current action, support, and finance options available appropriate to address L&D in Fiji's sugarcane communities?

4. What are the institutional and policy gaps in Fiji to assist farming communities to prevent, prepare, respond and recover from sudden and slow-onset climatic events?

5. What new policies would be appropriate and relevant to ensure mobilisation of enhance infrastructure, human capital, and funding for L&D?

Chapter 2 provided a critical examination of the political nature of L&D negotiations and evidence of L&D in vulnerable countries, including Fiji's sugar industry, and emphasised that the current action and support provided to vulnerable countries is inadequate to avert, minimise, and address L&D. Additionally, Chapter 2 integrated SES theory with vulnerability, adaptive governance, and transformational adaptation perspective to explicitly understand L&D in Fiji's sugar industry. Chapter 3 provided an overview of the research design, methods, and philosophical paradigm. Chapter 4 documented and analysed SES vulnerability to cyclones and droughts in Barotu and Toko settlements. By doing so, Chapter 4 addressed research objective 1.

- Research objective 1: Document the vulnerability of Fiji's sugarcane communities to sudden and slow-onset climatic events.

Chapters 5 and 6 examined cyclone and drought adaptation measures, adaptation constraints, and residual L&D in Fiji's sugar industry. These chapters examined if the current support and action provided by the Ministry of Sugar Industry are adequate to avert, minimise, and address L&D in Fiji's sugarcane communities. In doing so, these chapters addressed research objectives 2 and 3.

- Research objective 2: Identify current community-based adaptation strategies in Indo-Fijian sugarcane communities and residual L&D.
- Research objective 3: Assess whether the currently available support and action such as infrastructure, human capital, institutional arrangements, and mobilisation of L&D funding mechanisms are appropriate to address L&D in Fiji's sugarcane communities.

The final results chapter, Chapter 7, analysed climate change and DRR policies at the national and ministerial level, availability of human resource capacity, adaptation technologies, availability of data, and accessibility to climate finance for addressing L&D. Chapter 7 addressed research objective 4 which is to:

- Research objective 4: Evaluate institutional and policy gaps in Fiji to prevent, prepare, respond and recover from sudden and slow-onset events

This chapter provides a synthesis of key findings based on the aim and research objectives of the study. This chapter addresses research objective 5.

- Research objective 5: Construct the knowledge gathered to inform, design, and develop new support and action mechanisms such as infrastructure, human capital, and funding for sudden and slow-onset events for associated L&D.

This chapter provides an in-depth discussion of the results presented in Chapters 4 to 7. The key findings from Chapters 4 to 7 are presented in Sections 8.2 through to 8.5. This study contributes to the growing knowledge of L&D and captures the reality of L&D experienced in Fiji's sugarcane communities and its broader implications for communities 'living with' L&D. The knowledge gained from this analysis highlights the urgent need for transformational adaptation, institutional reforms and adaptative governance, integration of DRR and CCA, and mobilising L&D finance for averting, minimising, and addressing L&D (discussed in Section 8.6). Broader theoretical implications are presented in Section 8.7. This chapter also reviews limitations of this study and proposes opportunities for future research. Concluding remarks are presented in Section 8.10.

8.2 Vulnerability in social-ecological systems

This thesis used Pearce et al. (2018) vulnerability framework as a starting point to examine vulnerability in Barotu and Toko settlements. The vulnerability framework used by Pearce et al. (2018) is similar to the vulnerability model developed by IPCC (2007, 2014). The vulnerability model used by Pearce et al. (2018) and the IPCC (2007, 2014) presents current mainstream perspective and is an appropriate starting point for vulnerability analysis. Yet, there is a limitation in contextual application of the model presented by Pearce et al. (2018) at the community level. Therefore, the data collected from both field sites was used to critically develop SES vulnerability model at the local level.

This research emphasises that one crucial component missing from SES vulnerability model is the explicit consideration of 'social and ecological foundations' at the local level. For instance, in many climate change vulnerability studies, crucial aspects such as culture, livelihood aspects, socio-economic, socio-historical, geographical location, gender, traditional knowledge, and social and ecological health, are considered but analysed within exposure, sensitivity, and adaptive capacity domains (Chandra et al. 2017; Currenti et al. 2019;

McCubbin, Smit & Pearce 2015; Pearce et al. 2018). Using empirical evidence, this study argues that at the community level, these elements are integral components of SES vulnerability, need to be recognised as a key component of vulnerability assessments, and needs its own concept in vulnerability analysis. Therefore, this study refers to these elements as 'social and ecological foundations' of the system to be analysed.

This research defines social and ecological foundations as the current state and well-being of SES determined by broader social, economic, political, and ecological conditions. Similar to the findings of Kofinas & Chapin (2009), this thesis highlights that social dimensions of vulnerability are closely associated with livelihood capacity, well-being, sense of safety and security, and strong social relation while ecological dimension is closely linked with ecological stewardship. Recognising various aspects of social and ecological dimensions in climate change vulnerability studies is strongly tied to SES theory (Berkes, Colding & Folke 2001; Folke et al. 2016). Additionally, the inclusion of social and ecological foundations as a key component for SES vulnerability is justified because it provides a holistic and integrated approach in comparison to current mainstream perspective in understanding current and future SES vulnerability. Social and ecological foundations emphasise the interlinkages between social and ecological domains, that is, the complex interplay between individuals, community, ecology, their relationship, and feedback mechanisms. Social and ecological foundations also strongly influence exposure, sensitivity, impacts, and adaptive capacity. Using empirical data, Figure 8.1 has been developed, illustrating key components of SES vulnerability and how these components interact with each other.

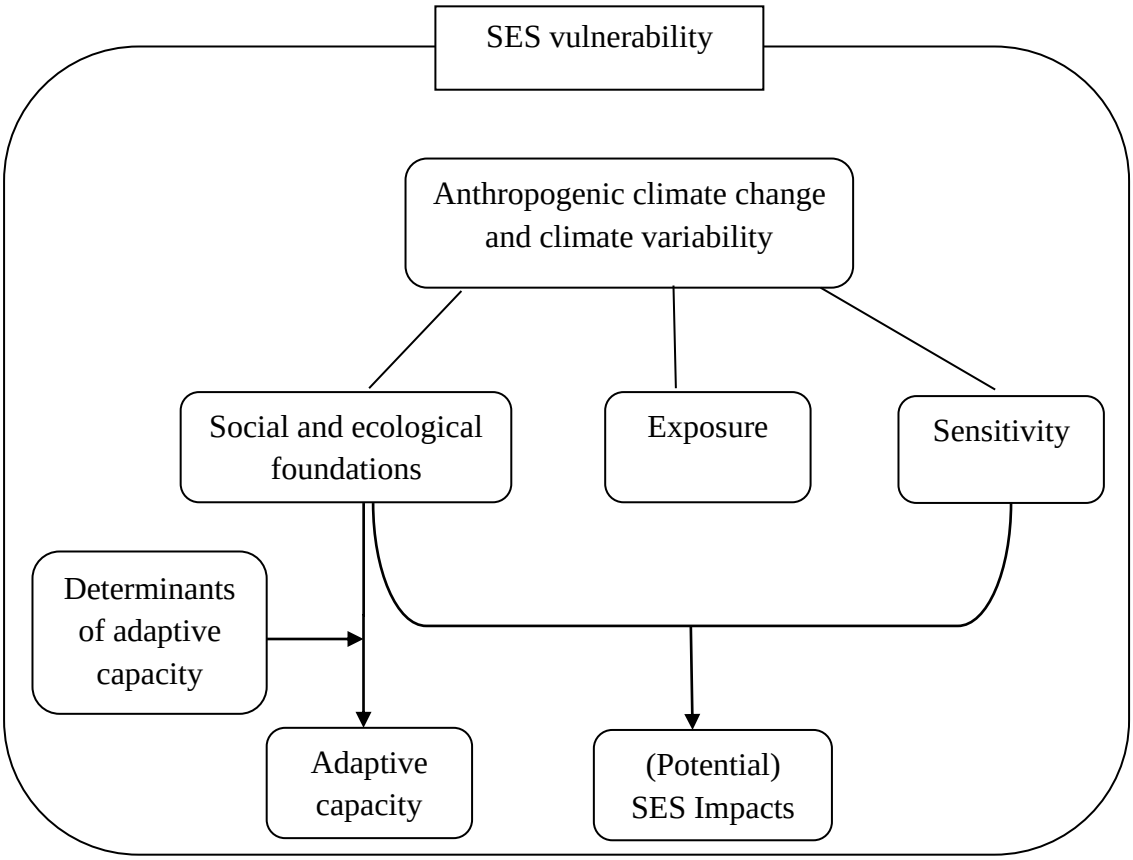

Figure 8.1 Incorporation of social and ecological foundations in social-ecological systems vulnerability framework

Therefore, building on Pearce et al. (2018), this thesis conceptualises SES vulnerability as a function of social and ecological foundations, exposure to bio-physical events, sensitivity to these exposures, determinants of adaptive capacity, adaptive capacity to deal with these changes, and impacts of cyclones and droughts on SES. The vulnerability analysis indicates a high vulnerability to cyclones and droughts in Barotu and Toko settlements. An in-depth discussion of various components of SES vulnerability is provided below in their respective sections (Sections 8.2.1 to 8.2.5). The vulnerability model illustrated in Figure 8.1 could be expanded to include adaptation and L&D (Figure 8.3).

In addition, for a better comprehension of climate change vulnerability, similar to the work of Pandey & Bardsley (2015), Smit & Wandel (2006) and Shabina et al. (2021), this thesis argues that it is imperative to consider a synergy of climatic and non-climatic factors for climate change vulnerability studies. The consideration of climatic and non-climatic factors is important because non-climatic factors are important determinants of local vulnerability (Birk 2014; Shabina et al. 2021). Climatic factors include the frequency, intensity, and duration of cyclones, floods, drought, changes in seasonal patterns, and changes in trends of hot days and rainfall. Non-climatic factors included livelihood strategies, farmers' perception, experience, and awareness of climate change, current farming practises, land tenure, access to livelihood assets, and support from key stakeholders. As discussed in later sections, the synergy of climatic and non-climatic factors influences adaptive capacity, SES impacts, implementation of adequate adaptation strategies, and resulting L&D.

The research further indicates a deeply interrelated and co-evolving relationship between different components of vulnerability. For instance, as part of social and ecological foundations, lack of livelihood options and land tenure insecurity increases sensitivity and constrains adaptive capacity. Furthermore, access to livelihood assets (physical, social, and financial capital), use of traditional knowledge, and access to information are integral components of both adaptive capacity and social and ecological foundations as they are used to respond to social and ecological change and maintain social and ecological well-being (Currenti et al. 2019). More importantly, this research argues that enhancing social and ecological foundations should increase social and ecological well-being which is crucial for SES resilience. Various components of SES vulnerability are discussed below in more detail.

8.2.1 Social and ecological foundations as a key component of vulnerability

As part of social and ecological foundations, this study examined farming and livelihood systems, socio-historical context, and current farming practices and their consequences on SES. The farming and livelihood systems in Barotu and Toko settlements include sugarcane farming as the primary source of income for farmers. However, due to rising cost of sugarcane production, lack of profit from sugarcane farming, and high cost of living, farmers have diversified into cash crop farming. While farmers have diversified their livelihood (Section 4.2.1), the current livelihood strategies are still exposed to cyclones and drought, sensitive to changing climatic conditions, and prone to impacts from cyclones and droughts. Therefore, other forms of locally appropriate adaptation measures such as livelihood and product diversification combined with new market opportunities is recommended (further discussed in Section 8.6).

The socio-historical context in the form of land tenure security is a crucial component of social and ecological foundations (Section 4.2.2). Evidence indicates that Barotu farmers face high uncertainty due to land tenure insecurity. Consequently, some farmers from Barotu settlement have relocated to other areas. Recent relocation research by Neef et al. (2018) in Ba province, Fiji, showed evidence of land tenure insecurity where land lease for an Indo-Fijian sugarcane community was cut short to accommodate relocation of Wavuwavu village. Additionally, land tenure security influences climate change adaptation in Barotu settlement. Testimony from Barotu Farmer 14 is evidence that tenure insecurity has constrained long-term farm investments. Due to land tenure insecurity and fear of evacuation, long-term farm investments could be seen as a waste of time and resources if farmers give up their land. The recently published IPCC's report on "Climate Change and Land" explicitly recognises the role of secure land tenure in climate change mitigation and adaptation (IPCC 2019b). The expiry of land leases has also caused loss of sugarcane farmers, sugarcane cutters, and other labourers from the sugar industry as well as loss of connection to birthplace, disruption to community cohesion, and an uncertain future. Therefore, both climatic and non-climatic factors have caused declined in sugarcane production and loss of sugarcane farmers from the sugar industry.

Research by Pearce et al. (2018) has highlighted that insecure land tenure enhances people's sensitivity to climatic events and constraints adaptive capacity. Research in Fiji's sugar industry by Kumari & Nakano (2016) and Prasad & Tisdell (2006) emphasised that weak tenure arrangements under formal leasing system have reduced farm investments. This finding is also supported by Balarabe, Elisha & Dayyabu (2017), who strongly believed that land tenure insecurity and marginalisation issues are barriers for farmers to adopt innovative farming practices for climate change adaptation. On the other hand, farmers from Toko settlement reported having secure land tenure but have failed to continuously adapt to climatic risks. It could be said that land tenure security is not the main driving factor for climate change adaptation in Toko settlement.

Unsustainable farming practices were documented in both settlements which revealed lack of consideration for ecological well-being. For instance, in most cases, farmers burned sugarcane for easier harvesting. However, burning of sugarcane deteriorated soil conditions and led to soil erosion. Farmers also practised intensive agriculture and intensified the use of fertiliser and weedicide to enhance agricultural productivity without realising the long-term consequences on soil health and the river system. In addition, farmers had adopted other unsustainable farming practices such as not living agricultural land fallow. Research in the PICs, including Fiji, has highlighted that intensive agriculture has resulted in diminishing fallow periods, lowering soil health and crop yield (Buckwell et al. 2020; Wairiu 2017). Another reason for land degradation is partly due to short-term agricultural land leases in Fiji. Short-term agrarian land leases in Fiji are not conducive to sustainable farming because farmers focus on maximising agricultural output with little consideration for the environment, knowing very well that their land lease would expire after 30 years (Prasad & Tisdell 2006; Wairiu 2017).

Finally, this research argues that ecological, economic, and socio-cultural dimensions of SES vulnerability are interrelated and a trigger or collapse in one of these domains will have a cascading effect and affect overall vulnerability of SES. For instance, unsustainable farming

practices seriously undermine ecological health which would adversely affect social well-being, that is, undermine food security and water security (Lauerburg et al. 2020; Pearce et al. 2018; Shabina et al. 2021). Hence, undermining or neglecting any component of SES would result in cascading effects, undermine adaptive capacity, and restrict essential feedback to identify vulnerable systems and prioritise adaptation measures (Webb et al. 2017). Finally, as part of social and ecological foundations, broader environmental, political, socio-economic, and socio-historical issues also affect exposure, sensitivity, and adaptive capacity (as discussed below).

8.2.2 Exposure to bio-physical events

Community perceptions in Barotu and Toko settlements revealed that farmers are experiencing hotter days, short and intense rainfall, an unpredictable seasonal calendar, more intense and frequent cyclones, and more prolonged and more severe droughts over the past decades. These oral narratives and lived experiences are substantial evidence of deeply intricate and multifaceted risks faced by the local communities. Their local experiences provide details of observed changes in the climate, the cause and rate of these changes, their ability to adapt or bear the effects of climate change, impacts on SES, and L&D.

Additionally, the proximity of the river, flat topography, and short and intense rainfall expose both settlements to flash flooding. According to Fiji's current and future climate projections, maximum and minimum temperatures have increased and will continue to increase in the near future leading to hotter days (CSIRO 2011). While the climate models show inconsistent results and uncertainty in trends related to rainfall, seasonal changes, and droughts, recent research in Fiji has documented unpredictable seasonal patterns and prolonged and severe droughts (Currenti et al. 2019; Pearce et al. 2018).

The research documents exposure to severe and frequent cyclones. In both settlements, most farmers observed significant changes in intensity and frequency of cyclones. Farmers perceived cyclones as multiple exposure event due to accompanying strong winds and heavy rain resulting in flash flooding. While Fiji's current and future climate projections project less frequent but more intense cyclones (CSIRO 2011), most farmers perceived more frequent, stronger, and more destructive cyclones as compared to the past. The discrepancy between local perception and climate model projections emphasises the importance of integrating local and scientific knowledge for adaptation planning (Gero, Méheux & Dominey-Howes 2011; Guodaar, Bardsley & Suh 2021; Magee et al. 2016). Integrating local and scientific knowledge could deepen the understanding of climatic risks and inform future adaptation measures (Magee et al. 2016).

Similarly, farmers reported experiencing severe and more prolonged droughts in both settlements in comparison to the past. However, there is spatial variation in respondents' perception of drought. Farmers from Toko settlement perceived longer and more intense drought than Barotu settlement. This spatial variation could be attributed to the geographical location of the communities as Toko settlement is in a much drier region. Interestingly, as described by farmers, the slow-onset and creeping nature of drought and the lack of an early warning system makes it difficult to predict a drought. This finding is supported by recent drought research in PICs by Iese et al. (2021). It is for this reason that agricultural communities such as Barotu and Toko settlements have become more exposed and sensitive to droughts with severe implications for water resources, agriculture, economy, and the

society. Moreover, this research emphasises that local perception and experiences of droughts could inform the scientific community and address limited knowledge on droughts in the PICs.

Farmers' perception of climatic risks was also based on temporal spacing of cyclones, droughts, and floods. Before TC Winston, farmers faced severe drought lasting eight months, drastically reducing crop yield and household income. Later, TC Winston aggravated agricultural communities and six weeks after TC Winston, TC Zena brought torrential rainfall and severe flash floods further devastating agricultural communities (Esler 2016). The research demonstrates that communities barely have time to recover from previous disasters when another disaster strikes. Therefore, exposure to multiple hazards within a short timeframe indicates that rebuilding houses, infrastructure, re-establishing farmlands, and recovery has become difficult for poor resource-constrained rural communities (Currenti et al. 2019; Magee et al. 2016; Rowan Gard & Veitayaki 2017). Exposure to multiple hazards and drought-cyclone-drought succession aggravates poverty levels, adversely impacts farmers' livelihood, enhances food insecurity, and results in severe L&D (Currenti et al. 2019; Esler 2016; Wewerinke-Singh & Salili 2019).

Finally, the findings from this research reveal discrepancies in farmers' awareness of the main reason for changes in exposure to bio-physical events. Farmers in Barotu settlement perceived changes in exposure as a result of climate change. In contrast, farmers in Toko made no connection to climate change but perceived the changes in climate as "not normal" and "not witnessed" in the past. According to the research findings, while Barotu settlement did not have access to social media, the majority of farmers were well informed of climate change issues and have shown a personal responsibility to stay updated on climate change matters through the local media. On the other hand, Toko farmers had access to social media, however, the majority of farmers in Toko indicated that they have not heard of climate change. The lack of climate change awareness could be partly why adequate adaptation measures were not implemented in Toko (as discussed in Section 8.3).

8.2.3 Sensitivity

Communities dependent on natural resources for livelihood are highly sensitive to climatic risks. Rain-fed agriculture and lack of irrigation in Barotu and Toko settlements increase sensitivity to changes in climate, particularly variation in rainfall. Research findings from Pearce et al. (2018) in Fiji's Vusama village also documented how heavy reliance on rainfall and resource-based livelihood systems increased sensitivity to climate change with severe implications for social and ecological well-being.

The research findings reveal that Toko farmers experienced longer and more severe droughts and were more sensitive to changes in rainfall patterns than Barotu farmers. Drought sensitivity in both settlements was further exacerbated due to their low adaptive capacity. Most farmers in Barotu and Toko settlements confirmed lack of access to livelihood assets such as water pumps for manually irrigating fields. Consequently, recent prolonged exposure to droughts and low adaptive capacity further increased drought sensitivity. Consistent with these findings, research by Shabina et al. (2021) in Waimanu River Catchment, Fiji, also highlighted that high exposure and low adaptative capacity results in increased sensitivity to climatic events.

Limited water supply is an inherent characteristic that increases drought sensitivity in Barotu settlement. The combined effect of Barotu settlements' limited water supply and difficulty farmers face in getting their water tanks refilled on time worsens drought sensitivity. Similar to these research findings, research by Pearce et al. (2018) in Vusama village, Fiji, also noted limited access to freshwater during drought which resulted in increased drought sensitivity and had adverse consequences for agricultural production, health and well-being, and adversely impacted livestock.

Moreover, climate sensitivity is aggravated due to land tenure insecurity. While participants from Toko settlement disclosed secure land tenure, farmers from Barotu settlement highlighted high cost of land rental and insecure land tenure which further increased their climate sensitivity. As discussed in Section 8.2.1, due to insecure land tenure, farmers were hesitant to implement adaptation measures. Recent research in Fiji has highlighted that land tenure insecurity limits farmers' adaptability and increases their sensitivity to current social and ecological changes (Balarabe, Elisha & Dayyabu 2017; Currenti et al. 2019; Pearce et al. 2018; Kumari & Nakano 2016). Therefore, this research reinforces that social and ecological foundation and sensitivity are interrelated.

8.2.4 Social-ecological impacts

This research documented severe impacts from cyclones and droughts. Severe cyclone impacts were noted in both settlements. Owing to high exposure, high sensitivity, and low adaptive capacity, farmers from both field sites reported reduced sugarcane and cash crop yield, damaged houses and other infrastructure, and severe flooding. Ecological impacts were noted such as washing away of farms near the river and introduction of invasive weeds on farms. Additionally, lack of livelihood options and climate-sensitive livelihood resulted in reduced household income and food insecurity. Such notable severe impacts of cyclones have also been documented in other Fijian communities (Chaston et al., 2016; Currenti et al., 2019; Esler, 2016; Thomas et al., 2018).

High exposure, high sensitivity, and low adaptive capacity resulted in devastating drought impacts. Severe droughts impacts were noted in both settlements. However, since Toko settlement is located in a more drought-prone region, farmers experienced severe and longer droughts and more devastating impacts in comparison to Barotu settlement. Impacts of drought included drying of the soil, burnt-like appearance of sugarcane, lack of germination, and lack of flowering in cash crops resulting in reduced crop yield. Similar to research findings of Warner & van der Geest (2013) and Yaffa (2013), this thesis notes that severe droughts resulted in reduced cash crop and sugarcane yield, lower household income, food insecurity, and higher food prices.

During drought, farmers from both settlements noticed increased pest outbreaks. Consequently, farmers intensified application of agrochemicals without realising long-term consequences for soil and river health. Currenti et al. (2019) also documented farmers intensifying use of agrochemicals as a short-term solution for declining yield without realising the long-term consequences for social and ecological well-being. Research by Shabina et al. (2021) and Webb et al. (2017) highlighted that a degraded ecological system would have severe consequences for human systems. For instance, a degraded ecosystem loses its capacity to safeguard local communities against hazards. In contrast, a well-managed ecosystem and its regulating services can buffer local communities against hazards and reduce

risks (Depietri 2020).

Evidence from this research suggests that current status of social and ecological foundations, high exposure, high sensitivity, and low adaptive capacity results in devastating impacts from cyclones and droughts. This finding is also supported by Pearce et al. (2018) research in Vusama village, Fiji which strongly indicated that lack of livelihood options, land tenure insecurity, high exposure, high sensitivity, and low adaptive capacity resulted in severe impacts in SES. Therefore, the severe impacts faced by agricultural communities, such as Barotu and Toko settlements, warrant more attention to the state of social and ecological foundations, exposure, sensitivity, and adaptive capacity.

8.2.5 Adaptive capacity

The research reveals that adaptive capacity varied among households and overall poor adaptive capacity was noted in both settlements due to limited livelihood options, lack of physical and financial assets, insecure land tenure, lack of stakeholder involvement, poor early warning system, and lack of access to climate change information.

To begin with, access to livelihood options is crucial for enhancing adaptive capacity (Warrick et al. 2017). The majority of sugarcane farmers in both settlements reported limited alternative livelihood options. Younger farmers were able to engage in off-farm employment during severe droughts to supplement household income. Many farmers reported lack of finance to undertake necessary adaptation measures during cyclones and droughts which undermined household adaptability, increased household vulnerability, and resulted in severe impacts and L&D. Scholars have highlighted that diverse livelihood options are integral for spreading out risks and diversifying household income as a means to reduce vulnerability (Biggs et al. 2012; Kafle 2011; Singh-Peterson & Iranacolaivalu 2018). Kofinas & Chapin (2009) also argued that sustainable livelihood strategies are necessary to reduce vulnerability so that people can engage in long-term planning.

Additionally, livelihood assets are primary determinants of community resilience and are crucial for experiencing and responding to social and ecological changes in the face of climate change (Currenti et al. 2019; Pandey & Bardsley 2015; Smit & Wandel 2006). The majority of households in both settlements did not have access to livelihood assets such as tractors, water pumps, and formal irrigation systems. Barotu farmers also faced insecure land tenure. Apparently, households lacking physical and financial assets and insecure land tenure had low adaptive capacity and were most sensitive to cyclones and droughts. Previous research by Neef et al. (2018) and Shabina et al. (2021) highlighted that communities with low adaptive capacity such as lack of physical and financial assets, lack of natural capital, and poor ecosystem health are most vulnerable to natural hazards. More importantly, access to livelihood assets is crucial in determining livelihood options and opportunities for climate change adaptation (Wang, Huang & Wang 2014). For example, farmers with trucks could diversify their livelihood by engaging in driving trucks to supplement household income.

Farmers from both field sites used traditional knowledge and local observation to prepare and respond to cyclones and droughts. Previous research in rural Pacific communities documented the significance of local experiences and traditional knowledge for cyclone and drought preparedness and implementation of adaptation responses (Janif et al. 2016; McNamara & Prasad 2014; Nakamura & Kanemasu 2020). Traditional knowledge has accumulated over

many generations and is instrumental for understanding local-level changes, responding to social and ecological changes, and enhancing adaptive capacity of communities (Mcleod et al. 2019; McNamara & Prasad 2014; McNamara & Buggy 2017; Veitayaki 2010; Wolf & Moser 2011). Accordingly, traditional knowledge and local observation are significant aspects of social and ecological foundations as it creates awareness, enhances adaptive capacity, and preparedness for cyclone and droughts.

Access to early warning for cyclones and droughts is crucial for reducing risks and enhancing farmers' adaptive capacity (Magee et al. 2016). Early warning systems would enable early action which is imperative for reducing climatic risks (UNFCCC 2019a). In Barotu, the lack of access to internet and poor mobile phone coverage undermines access to timely cyclone alerts resulting in low adaptive capacity. In contrast, Toko settlement has good internet access and mobile phone coverage. Regardless, farmers from both settlements relied on radio and strong community networks for cyclone alerts. Findings from this research indicates that social capital and social networks and reliable and timely dissemination of disaster information through the local radio is critical for public risk awareness, disaster preparedness and response, enhancing adaptive capacity, and reducing impacts in remote rural communities. Previous research in Fiji also documented the importance of radio as well as community bonds for disaster preparedness and response (Chandra & Gaganis 2016; Magee et al. 2016; Nakamura & Kanemasu 2020; Yila, Weber & Neef 2013). On the other hand, due to lack of an early warning system for drought, farmers relied on their personal observations and traditional knowledge.

Moreover, the lack of institutional support provided by the agricultural officers in Barotu and Toko settlements acts as a barrier for enhancing adaptive capacity. Farmers from both settlements raised concerns that the agricultural officers do not hold information sessions on cyclones, droughts, and climate change. As a result, farmers have inequitable access to disaster and climate change information which undermines disaster preparedness and implementation of adequate adaptation measures. Research has shown that agricultural officers play an integral role in disseminating new knowledge, skills, and technologies, and advising farmers on sustainable soil practices, natural resource management, and adoption of appropriate DRR and CCA measures (Agrawala et al. 2003; Hunt et al. 2014; Mcleod et al. 2019; Raymond & Robinson 2013). Additionally, agricultural officers can also benefit through community engagement. Community engagement could facilitate two-way information flow and sharing of skills between farmers and the agricultural officers (Malsale et al. 2018).

Overall, in line with previous research findings (see Dumaru 2010; Kuruppu & Willie 2015; Mcnamara & Westoby 2020; Shabina et al. 2021; Warrick et al. 2017), this thesis confirms that enhancing adaptive capacity is crucial for reducing SES vulnerability and for facilitating implementation of adaptation measures.

8.3 Documenting adaptation measures for cyclones and droughts: A case study from two Indo-Fijian sugarcane communities

As a starting point of analysis, adaptation framework proposed by Moser & Ekstrom (2010) and Rickards & Howden (2012) was used to document adaptation measures in Barotu and Toko settlements. Empirical evidence from this research indicates four categories of adaptation measures were implemented in Barotu and Toko settlements. These adaptation

strategies included bearing the effects of cyclones and droughts, coping measures (reactive and short-term behavioural changes), incremental adaptation, and systems adaptation. Erosive adaptation measures and adaptation constraints were also noted in both settlements.

Evidently, the level of adaptation being pursued in Fiji's sugar industry depends on household and institutional adaptive capacity, that is, access to livelihood assets (financial, physical, and social capital), access to secure land tenure, climate change awareness, and institutional capacity. Due to lack of adaptive capacity, most of the adaptation measures implemented were coping and incremental measures. This research indicates that coping and incremental adaptation will not be sufficient to avoid intolerable risks and irreversible L&D. This is because coping and incremental adaptation measures are reactive measures and do not address underlying SES vulnerability or improve social-ecological conditions (Matyas & Pelling 2015; McCubbin, Smit & Pearce 2015). Consequently, the research findings draw attention to transformational adaptation which is missing from Fiji's sugar industry.

Drawing on Moser & Ekstrom (2010) and Rickards & Howden (2012), and based on the results provided in Chapters 5 and 6, a conceptual framework (Figure 8.2) has been developed. Figure 8.2 illustrates the various levels of adaptation under increased degree of climate change (x-axis) and benefit from adaptation (y-axis). Bearing the effects of cyclones and droughts could be placed anywhere along the x-axis (x,0) because there is no adaptation benefit from bearing the effect of cyclones and droughts under increased degree of climate change. Figure 8.2 also demonstrates that under increased degree of climate change, higher levels of adaptation measures are required.

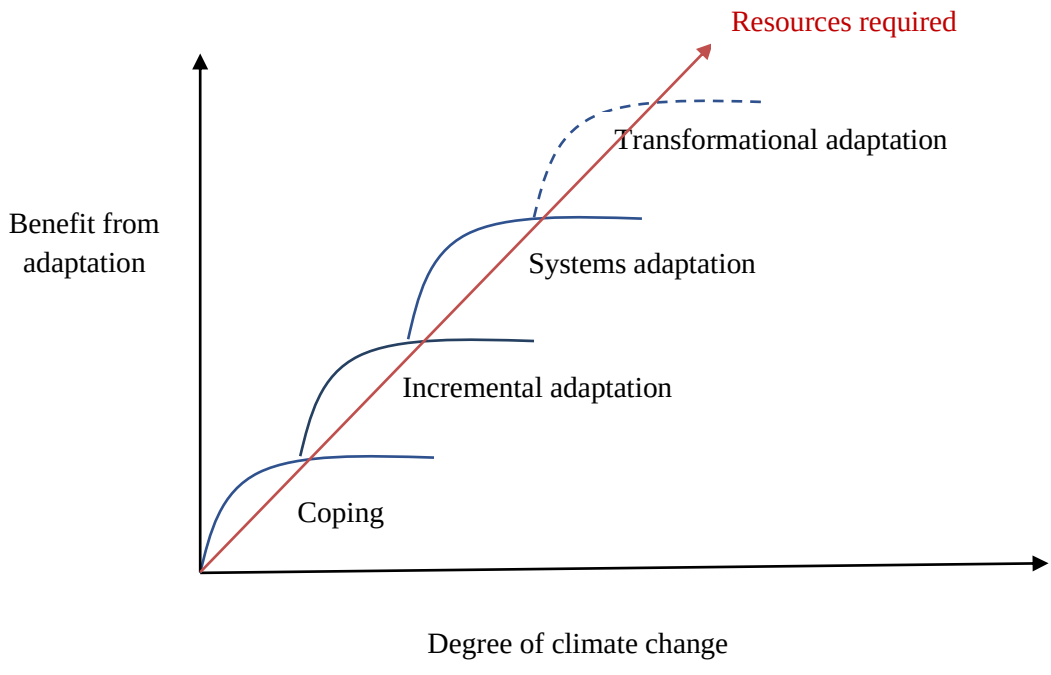

Figure 8.2 Various levels of adaptation in relation to benefit from adaptation under increased degree of climate change

Moreover, Figure 8.2 demonstrates a "step-change" transformational adaptation approach. A "step-change" transformational adaptation begins with coping and extends through to systems

adaptation and finally transformational adaptation. Additionally, the research findings highlight that in resource-constrained region, transformational adaptation does not have to be a radical or an abrupt and sudden change in SES but an on-going systems co-evolution. Within SES, systems co-evolution includes the processes whereby regulatory, governance, economic structures, as well as technologies are continuously evolving to meet current and future needs (Morrison & Nand 2023). In Fiji's context, transformational adaptation could be non-marginal changes and a continuous process under changing climatic conditions (on-going systems co-evolution). However, it should be noted that implementing transformational adaptation would require higher levels of adaptive capacity (Rickards & Howden 2012).

Finally, this research argues that systematically identifying various levels of adaptation measures undertaken in Fiji's sugar industry can advance our understanding of adaptation practices, resulting L&D, and present opportunities for policy options. The section below provides an in-depth discussion of various adaptation measures implemented in Fiji's sugar industry.

8.3.1 Documenting adaptation measures for cyclones

Farmers from Barotu and Toko settlements reported similar trends of cyclone adaptation measures, that is, farm protection measures, property protection measures, and personal protection measures prior to a cyclone. Adaptation measures for cyclone are further categorised as bearing the effects of cyclones, coping measures, incremental adaptation, and systems adaptation. No transformational adaptation was noted for cyclones.

Absence of adaptation measures were noted in the sugarcane farms. Instead, farmers had to bear the consequences and accepted severe impacts and resulting L&D. Vulnerable communities and rural smallholder farmers bear some of the worst climate change impacts (Chillrud 2017; Farbotko & Lazrus 2012). According to McCubbin, Smit & Pearce (2015), bearing the effects of a stressor is a response employed for conditions people view as inevitable. Therefore, people attempt to do nothing, accept the loss, and put their faith in God.

Some farmers implemented reactive and short-term coping measures on their vegetable farms, for example, cutting stems of crops closer to the ground, hand-picking matured crops, and moving livestock to higher grounds. Recent research by Magee et al. (2016) and McNamara & Prasad (2014) noted similar trends of coping measures in Fijian villages. Additionally, incremental adaptation measures implemented in both settlements are erosive. For example, farmers chose to plant fewer cash crops during the cyclone season which undermines household income and food security irrespective of the experiences during the season. Systems adaptation in both settlements included relocating small vegetable plots next to the house to minimise flood and cyclone risks. This adaptation intervention minimised flood and cyclone risks while ensuring food security. Recent research on adaptation studies have highlighted that systems adaptation offers increased benefits compared to incremental adaptation (Rickards & Howden 2012; Howden et al. 2013) and enables a process of creating a new and better system (Rickards & Howden 2012; Morrison 2021).

In addition, farmers reported adaptation constraints while preparing for cyclones. For example, women farmers reported feeling overwhelmed and overburdened with work and stated that they needed assistance to prepare for cyclones. Similar to Chandra & Gaganis (2016) findings in Nadi, Fiji, this thesis highlights that women have weak capacity to prepare

and respond to climatic stressors. This could be partly attributed to women's demographic attributes and socio-economic standing which have often been cited as factors that marginalise women and increase their vulnerability to climatic stressors such as cyclones (Chandra & Gaganis 2016; Clissold, Westoby & McNamara 2020; Thomas et al. 2018).

Farmers also faced financial constraints while when preparing for cyclones. Due to financial constraints, farmers could not implement property protection measures such as securing their houses. One farmer mentioned that the cyclone season coincides with the new school term, therefore, farmers also had to save money for school expenses. In the PICs, financial constraints have often been highlighted as a major adaptation constraint (Currenti et al. 2019; McCubbin, Smit & Pearce 2015; Thomas et al. 2018). Additionally, some farmers admitted that they were ill-prepared for TC Winston. Farmers reported that they were informed that the cyclone would not reach their area. However, the cyclone suddenly changed directions and farmers did not have sufficient time to prepare. Recent research by Magee et al. (2016) and Nakamura & Kanemasu (2020) on tropical cyclone perception in PICs highlighted that cyclone warning could be improved through more frequent cyclone updates and more accurate weather reports so that communities could better prepare for cyclones.

Adaptation measures implemented by the Ministry of the Sugar Industry includes incremental and systems adaptation measures. Incremental adaptation measures include farmer outreach and support programmes. However, the findings from this research indicate that farmers do not trust agricultural officers. The lack of trust could be partly explained by lack of engagement of agricultural officers in sugarcane communities due to the shortage of agricultural extension officers in Fiji (Kumar & Bhati 2011). Due to the lack of extension officer engagement, sugarcane farmers are left to manage on their own. Some farmers raised concerns that extension officers are less informed and less skilled in assisting farmers in understanding and applying climate adaptation measures.

At the institutional level, the Ministry of Sugar Industry implemented systems adaptation. For example, farmers are encouraged to diversify their livelihood by planting short-term crops which would supplement household income. Recent research in Fiji's sugar industry has highlighted that sugarcane farmers who engaged in livelihood diversification achieved higher farm profitability as compared to farmers who relied on sugarcane alone (Singh 2020). Studies have also shown that livelihood diversification enhances local resilience and spread-out risks in social systems (Clissold, Westoby & McNamara 2020; Giannini et al. 2021).

Finally, the Ministry of Sugar Industry also encourages breeding and adoption of new climate-resilient sugarcane varieties. Regardless, adopting new varieties remains a challenge because farmers prefer to cultivate the traditional Mana variety due to the cane payment system which is based on the weight payment system instead of the sugar content payment system. Although extension services encourage farmers to adopt new sugarcane varieties (Lal 2000), a research by Mahadevan (2009) on Fiji's sugar industry revealed that 64 percent of farmers were unaware of the newer and improved sugarcane varieties.

8.3.2 Documenting adaptation measures for droughts

Similar drought adaptation measures were documented in Barotu and Toko settlements. Current drought adaptation measures in Barotu and Toko settlements included bearing the

effects of droughts, incremental adaptation measures, and systems adaptation. No transformational adaptation was noted for drought.

Since the sugarcane farms are rainfed and lack formal irrigation systems, farmers could not water their sugarcane farms. Instead, farmers had to bear the consequences and accepted severe impacts and resulting L&D. Additionally, due to lack of agricultural officer engagement during drought, farmers have stopped relying on agricultural officers. Instead, farmers coped by adopting a 'do it yourself' attitude and have begun to implement adaptation measures that they think are right and within their capacity to sustain their livelihood. Recent research by Currenti et al. (2019) also noted villagers adopting a 'do it yourself' attitude to sustain livelihood against climatic stressors due to lack of trust in government systems.

Incremental adaptation included ensuring reliable water supply for farm and domestic use, planting less and modifying food consumption, relying on family support and personal savings, and selling livestock. Previous research on drought have also documented similar adaptation measures in rural communities (McCubbin, Smit & Pearce 2015; McNamara & Prasad 2014; Pearce et al. 2018; Traore & Owiyo 2013; Yaffa 2013). Due to limited water supply in Barotu, households have adapted to drought by investing in alternative water sources such as boreholes, water wells, and water tanks. Regardless, the findings from this research indicate that households with water tanks faced difficulty getting their water tanks refilled on time and were confronted with insufficient water for domestic use.

Additionally, planting less, modifying food consumption (eating less), relying on personal savings, and selling livestock are incremental yet erosive measures. For instance, during severe droughts, farmers were compelled to plant less which resulted in reduced household income and food security. Drought-induced food deficit or consumption of less food could indicate that existing climate adaptation strategies are failing and beyond people's capacity to adapt (Warner & van der Geest 2013; Yaffa 2013). To overcome the risk of food insecurity, farmers used their personal savings to buy food items at higher prices from the local market. Personal savings was also used to send children to school. As a result, farmers drained their personal savings. Consequently, reduced household income, food insecurity, and use of personal savings perpetuates a vicious cycle of hardship and poverty and increases vulnerability to future climatic stressors (Warner & Afifi 2014; Yaffa 2013).

Poor households also adapted to drought by selling livestock, such as cows. Although bullock pairs are highly desirable for ploughing and land preparation in Fijian agriculture (Currenti et al. 2019), farmers from Toko and Barotu settlements sold their livestock due to failed harvests and reduced household income. A study by Gani (1999) on Fiji's previous droughts also suggested that households sold their livestock to buy food when harvest failed. However, selling cows is considered an erosive strategy as these households will be unable to plough their fields and prepare their land when the next planting season arrives (Warner & van der Geest 2013). In most cases, wealthy members of the farming community take advantage of this opportunity and acquire farm assets at a lower price from the distressed sale of the poor farmers (Gani 1999).

Evidently, in both settlements, incremental adaptation is geared towards maintaining cash crops as this is a source of regular income and food for the households. Due to lack of formal irrigation systems, participants resorted to use river water to water their cash crops.

Households with water pumps used their water pumps to water the vegetables while households without water pumps used drums and buckets to manually fetch river to water their plants. Households with access to water pumps proved more adaptive as compared to households without water pumps. In alignment with previous studies by Currenti et al. (2019), Li et al. (2009), and Warrick et al. (2017), this thesis argues that household's ability to adapt to changing climatic conditions is determined by their access to livelihood assets.

Systems adaptation included seeking off-farm employment and income diversification. During drought, younger sugarcane farmers engaged in livelihood diversification, such as driving trucks, to supplement household income. Consequently, farm and off-farm employment were used to buy food, send children to school, and meet other household expenses. Recent adaptation discourse has also highlighted benefits of livelihood diversification such as supplementing household income and spreading out risks (Gounder 2007; Klöck & Nunn 2019; Singh 2020; Zhongwei 2015).

At the institutional level, the Ministry of the Sugar Industry's adaptation measures includes incremental and systems adaptation measures. Incremental adaptation included sustainable farm and soil management practices, irrigation programmes, provision of weather and climate outlooks, and farmer outreach and advice. Systems adaptation included breeding new climate-resilient sugarcane varieties and encouraging livelihood diversification. To sustain a healthy farm system during drought, the Ministry of Sugar Industry is encouraging sustainable farm management practices, including traditional practices such as intercropping, green manuring, use of mill-mud, and leaving land fallow. Likewise, the Ministry of Sugar Industry discourages land degradation practices such as burning of sugarcane. Recent studies in Fiji's sugar industry by Asafu-Adjaye (2008), Mahadevan (2008), and Wairiu (2017) highlighted that unsustainable farm practices, lack of soil conservation, and land degradation led to major yield reductions.

Although the Ministry of Sugar Industry is encouraging sustainable farm practices, during field visit it was observed that farmers from both settlements are still practising monoculture and intensified use of fertiliser and weedicide. Research has shown that the practice of monoculture in SES results in loss of biodiversity, pest outbreaks, environmental degradation, increased vulnerability to changing climatic conditions, and systemic collapse (Ahlborg et al. 2019; Folke et al. 2016; O'brien et al. 2004; Sterk, van de Leemput & Peeters 2017; Stringer et al. 2020).

The Ministry of Sugar Industry is implementing irrigation programmes to assist drought-affected communities. The Ministry of Sugar Industry provides water tanks to irrigate fields. In Fiji, the provision of water tanks to irrigate the fields in drought-stricken areas is becoming increasingly common (Weber 2016). Nonetheless, the testimonies from farmers indicated absence of irrigation programmes and lack of key stakeholder involvement – an indication that targeted support provided by the Ministry of Sugar Industry is not reaching vulnerable communities leaving farmers to manage on their own.

Apparently, systems adaptation, such as income diversification, allows for some degree of change in SES against increased climate change (Rickards & Howden 2012). For instance, farmers engaged in off-farm employment during drought to supplement household income, buy food, and send children to school. Therefore, systems adaptation provided more benefit

than other adaptation measures such as coping, incremental, and erosive adaptation measures. While systems adaptation provides some benefit under increasing climate change conditions, higher-level adaptation measures are still required under an increased degree of changing climatic conditions and to redirect the SES towards improved social and ecological conditions.

8.4 Anthropogenic climate change loss and damage: A case study from two Indo-Fijian sugarcane communities

For this research, L&D is defined as adverse consequences of climate change and climate variability in which current adaptation and mitigation measures are insufficient to avert, minimise, and address L&D and which could have a 'spiralling and intergeneration effect' on SES. For the purpose of analysis, this research used L&D framework conceptualised by van der Geest & Warner (2015) which has been developed through evidence-based L&D research in four African and Asian countries. Using the L&D conceptual framework, van der Geest & Warner (2015) clearly articulated the link between vulnerability, coping, adaptation, and L&D. Empirical evidence from various L&D studies have proposed comparable framing of L&D (Monnereau & Abraham 2013; Warner & van der Geest 2013; Yaffa 2013). Figure 8.3, an extension of vulnerability framework (Figure 8.1), builds on the conceptual framework proposed van der Geest & Warner (2015).

While van der Geest & Warner (2015) explicitly discuss residual L&D as a result of inadequate adaptation measures, absence of adaptation measures, adaptation constraints, and erosive measures, one crucial element missing from their research is that the scholars do not specify different categorises of L&D documented in the communities and the interlinkages between economic L&D, NELD, and intergeneration impacts. Building on van der Geest & Warner (2015), section 8.4.1 and 8.4.2 examines various categories and conceptualisation of L&D as proposed by Verheyen & Roderick (2008), that is, avoided, unavoided, and unavoidable L&D. More importantly, avoided, unavoided, and unavoidable L&D includes economic, non-economic, and intergenerational impacts for some individuals that may not be necessarily recognised by the other individuals. Therefore, an understanding of local values is important in determining how people experience and deal with L&D.

As illustrated by Figure 8.3, avoided L&D results from implementing adequate adaptation. When no adaptation or inadequate measures are implemented, unavoided and unavoidable L&D are experienced. Unavoided L&D occurs due to adaptation constraints while unavoidable L&D occurs regardless of adaptation measures implemented (Verheyen & Roderick 2008). Examining different categorises of L&D could provide opportunities for policy, planning, and funding mechanisms for addressing L&D within the sugar industry of Fiji.

Finally, in their conceptual framework, van der Geest & Warner (2015) highlighted the critical role of feedback mechanism. Adding on van der Geest & Warner (2015), this thesis emphasises that apart from feedback, feedforward mechanism is also essential to reduce SES vulnerability and avoid L&D. Feedback and feedforward mechanism (indicated by dashed arrow in Figure 8.3) at every stage feeds into SES vulnerability and would assist in initiating research, nurturing adaptive capacity, and engaging in higher level of adaptation (transformational adaptation) to enhance well-being of SES (Morrison 2021; Morrison, Nand & Lal 2019).

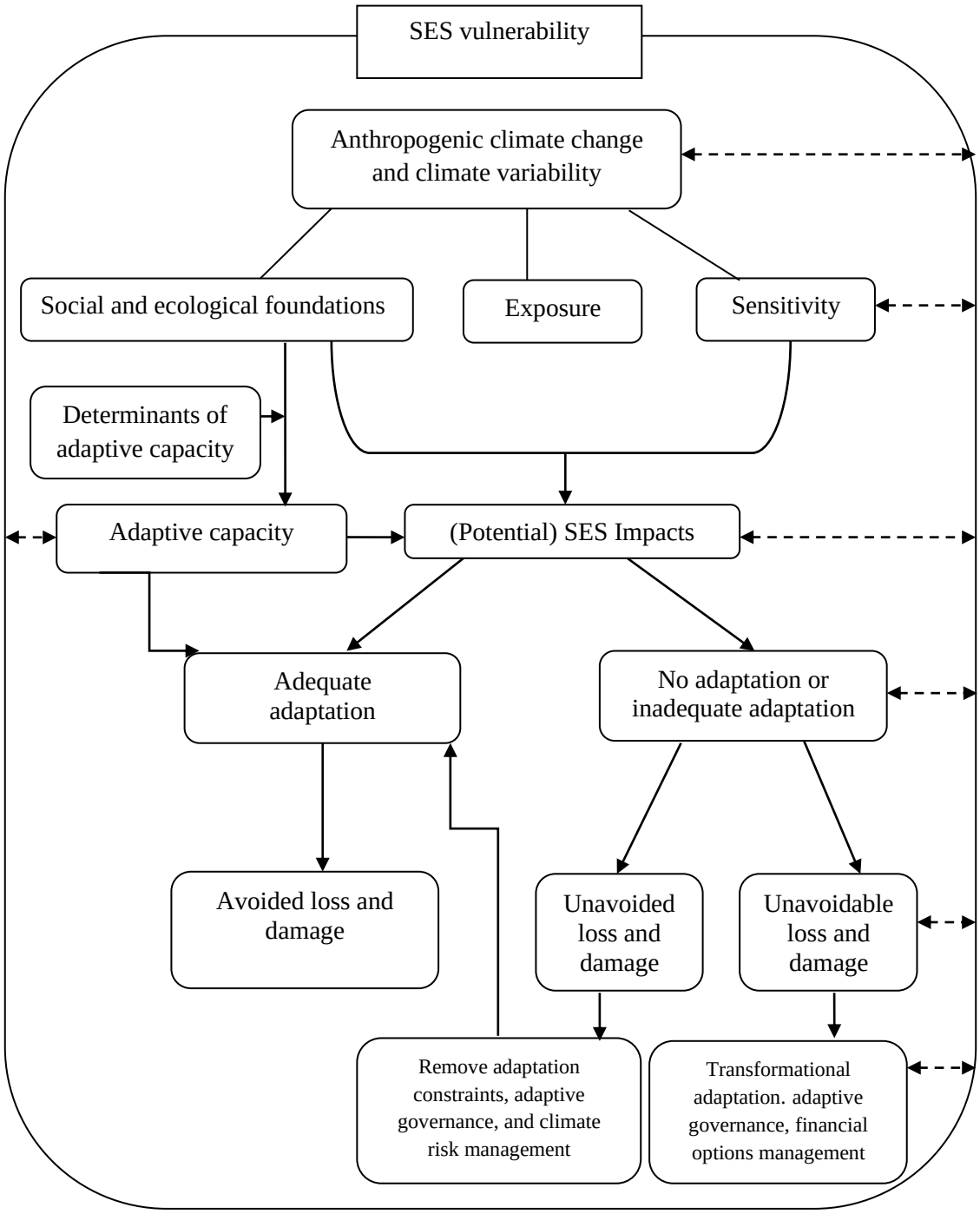

Figure 8.3 Climate change loss and damage conceptual map

8.4.1 Documenting loss and damage from cyclones

As discussed in Section 8.3, farmers from Barotu and Toko settlements implemented coping, incremental, and systems adaptation measures for cyclones. The research findings emphasise that adaptation measures implemented by farmers are inadequate to avert and minimise L&D. Consequently, farmers had to accept severe L&D such as loss of property, crops, and income. In many cases, farmers became homeless and lived in tents for extended periods, with some poor and marginalised farmers still living in partially incomplete homes three years after TC Winston. Fiji's sugar industry also recorded its lowest sugarcane production and L&D to vital infrastructure such as closure of the Penang mill.

This thesis documented how farmers are 'just getting by' and 'living with' L&D. From a practical perspective, living with unavoidable L&D suggests that farmers have accepted L&D which is not normal. The severity of unavoidable L&D experienced indicates that the communities are living with trauma, have approached social and ecological limits, and continue to exist precariously between boundaries of 'safe' and 'unsafe' operating spaces at the adaptation frontier with intolerable risks that threaten the sustainability of SES (Adger et al. 2009; Biermann & Kim 2020; Birkmann 2011; Dow et al. 2013; Mechler et al. 2020; Preston, Dow & Berkhout 2013). Limits to adaptation indicate that L&D is happening now and current adaptation measures in vulnerable communities are inadequate to prevent L&D from sudden and slow-onset events (McNamara & Jackson 2019). Apart from unavoidable agricultural L&D, many low-lying and coastal communities are relocating due to rising sea-levels, severe storm surges, salt-water intrusion, and rising water and food security issues (Charan, Kaur & Singh 2018; Handmer & Nalau 2019; Tabe 2019). Therefore, a better understanding of social and ecological limits can inform L&D debates and policy outcomes. NELD documented in both the field sites included uncertainty, fear and trauma, and loss of homes and places of worship. Participants' perception of NELD was that NELD could not be monetised because it is difficult to measure or quantify. Some participants perceived loss of homes as NELD because of sentimental value. Additionally, loss of places of worship and cattle were considered NELD because of religious significance. The findings also demonstrate that people perceive NELD differently based on personal experiences and social constructs. For example, a farmer considered loss of a home that existed for many generations as NELD, while to an outsider, that particular home could just be a house and would be conceptualised as an economic loss. Therefore, this research argues that NELD is highly context-specific and largely depends on what people value. Additionally, such damages to family homes are considered irreversible loss. This is because repairing a family home could make it more disaster resilient but it does not bring back the essence or the value of that building. Therefore, such damages become a "loss" when NELD is considered.

It is also important to emphasise that the distinction between economic L&D and NELD may be a grey area. For instance, loss of houses could be considered economic while loss of homes could be non-economic in nature. Similarly, loss of livestock could be economic for some individuals and non-economic for others. The documentation of L&D in local rural context emphasises the nature of L&D and people's lived experiences of L&D. Economic and non-economic losses have been highlighted in the literature and also aligned to UNFCCC's classification of L&D. Of greater concern is that while the UNFCCC provides a list of NELD with three major categories: individual, society, and environment (UNFCCC 2021a), this thesis argues that UNFCCC's broad NELD categorises do not fully capture NELD experienced at the local level – emphasising the need to reframe L&D in the local context. Therefore, for effective and meaningful policymaking, local experiences and local context of L&D needs to be properly understood.

The critical social and ecological limits, threshold of L&D acceptance, and poor understanding and growing concerns of NELD have drawn crucial insights into how people experience NELD, what people value, and how people engage with losses (Barnett et al. 2016; McNamara & Jackson 2019; Tschakert et al. 2019, 2017). Recent research on NELD in the PICs aimed to improve understanding of NELD (McNamara, Westoby & Chandra 2021; McNamara et al. 2021). Yet, these studies again aligned with UNFCCC's classification of

NELD and do not critically evaluate if the current NELD categories should be expanded. Therefore, misalignment of the UNFCCC's NELD categories and NELD experienced locally could result in policy gaps in addressing NELD. Hence, more research is required to understand NELD at the local level. Additionally, expanding on McNamara, Westoby & Chandra (2021), this thesis highlights the importance of recognising psychological trauma after a climatic event. Farmers emphasised deterioration of emotional and mental health which is still clearly evident many years after TC Winston. The experiences of sugarcane farmers in Fiji suggest that L&D, including NELD which often goes unchecked or unnoticed, could undermine SES, increasing future catastrophic climatic risks.

The research findings also reveal that poor households faced L&D which had compounding and cascading effects. Cascading effects and interconnected nature of L&D were evident on social and ecological well-being such as household food security, children's education, and degradation of ecosystems and their services. Evidently, L&D, including NELD and cascading impacts, are not occurring separately to human and ecological systems but are inherently interconnected in nature. Similar cascading and interconnected nature of L&D have been recognised in other PIC studies (McNamara, Westoby & Chandra 2021; McNamara et al. 2021; Pearce et al. 2018; Thomas et al. 2018; Westoby et al. 2022).

Additionally, female farmers suffered severe L&D as compared to male farmers. For example, one female farmer mentioned that TC Winston severely affected her socio-economic status which has been set back twenty years. This could be partly explained by women's huge responsibility toward household and farm commitments and lack of time and assistance to prepare for disasters (Chandra et al. 2017). A L&D study by van der Geest & Warner (2015) similarly highlighted that vulnerable and marginal households, and households led by women, are particularly more vulnerable and suffer severe impacts and L&D. The relatively weak capacity to prepare and respond, demographic attributes, and socio-economic standing are regularly cited by scholars as factors that marginalise women and increase their vulnerability to climatic stressors (Chandra & Gaganis 2016; Clissold, Westoby & McNamara 2020; Thomas et al. 2018). Evidently, the scale and impact of L&D experienced by different social groups is a product of differentiated vulnerability (Boyd et al. 2021). Therefore, L&D research, such as this, is vital to provide an opportunity to critically reflect not only on the effectiveness of adaptation measures but also on the root causes of SES vulnerability and opportunities for transformation (Boyd et al. 2021) (see Figure 8.3 and Section 8.6).

Much of the residual climate change L&D in Fiji's sugar industry described here is irreversible and could be categorised as unavoidable L&D. According to Verheyen & Roderick (2008), unavoidable L&D cannot be avoided through mitigation and adaptation measures because no adaptation measure would assist in preventing L&D. Research on L&D in vulnerable countries have documented the similar implementation of short-term and inadequate adaptation measures that inevitably resulted in severe L&D (van der Geest & Warner 2015; Monnereau & Abraham 2013; Warner & Afifi 2014; Yaffa 2013). As discussed, such severe L&D, when unaddressed, can be risk multipliers for future L&D. Therefore, mechanisms for addressing L&D and preventing cascading effects in SES need to be prioritised (as discussed in Section 8.6).

At the national level, the Prime Minister's fund was mobilised after TC Winston for disaster response and relief purposes to address L&D. According to Esler (2016), Fiji Prime Minister's

fund, also known as the National Disaster Relief and Rehabilitation Fund, can release up to FJ$1 million for any disaster. The recently established Rehabilitation Fund also receives an annual funding of FJ$2 million. However, for disasters such as TC Winston, estimated losses and damages amounted to FJ$1.99 billion (Esler 2016), indicating the severity of L&D and the government's inadequacy to respond effectively. Social protection programmes and humanitarian efforts were scaled up to provide relief to the most vulnerable (Mansur, Doyle & Ivaschenko 2017). The Fijian government also received strong support from donors, civil society, humanitarian partners, and international community (Mansur, Doyle & Ivaschenko 2017). However, the majority of the L&D from TC Winston remained unfunded (Richards 2018), including compensation for livestock, loss of homes, and ecosystems degradation.

8.4.2 Documenting loss and damage from droughts

The findings reveal that drought adaptation measures implemented by the sugar industry were inadequate to avert and minimise L&D. Empirical evidence from this research indicates that farmers suffered severe L&D such as loss of crop yield, loss of livelihood, and loss of income. Previous studies in Fiji have also highlighted that meteorological droughts in the agriculture sector led to an economic loss of UD$23-52 million, equivalent to 3 percent of Fiji's GDP (Deo 2011). According to Wairiu (2017), severe droughts in Fiji have resulted in 50 percent loss in sugarcane production. For example, in 1997/1998 drought, the sugar industry faced loss of US$50 million (Wairiu 2017) and saw a decline in sugar exports by nearly 30 percent (Zhongwei 2015). In 2015, a well below the target of 1.86 million tonnes was recorded due to drought experienced in 2014/2015 sugarcane planting season (FSC 2015).

Empirical evidence from this research reveals that NELD, including cascading effects, presents itself in various ways and could affect future generations. NELD in both settlements included food insecurity risks, serious health issues and disease outbreaks, deterioration of mental and emotional health, uncertainty, trauma, loss of hope, and deteriorating ecological health. The findings highlight that households faced food insecurity due to lack of cash crops. Food shortages were also commonly experienced due to lack of income and rising food prices. Lack of access to nutritious food had an impact on farmer's health and well-being. Research on Fiji's severe drought of 1997/1998 by Gani (1999) also noted similar implications on quality of life due to households' restricted access to nutritious food. Drawing on Gani (1999), this thesis argues that quality of life not only depends on access to food but also on physical, mental, and emotional health.

Farmers expressed concern regarding severe deterioration of mental and emotional health. Farmer's diminishing mental and emotional health was deeply associated with uncertainty related to receiving rainfall and declining ecological health. In severe cases, farmers reported loss of hope and had no option but to wait for the drought to pass. Declining ecological health such as dryness of soil and depletion of soil moisture resulted in reduced crop yields and household income which further deteriorated farmers' mental and emotional health. Furthermore, the research findings demonstrate that unsustainable soil and farming practices such as intensive farming and burning of sugarcane are contributing to ecological degradation and increasing risk of future farm losses. For example, ecological system degradation could have severe consequences for human systems adversely affecting future food and water security (Currenti et al. 2019; Shabina et al. 2021; Webb et al. 2017). Similar to McNamara et

al. (2021) and Westoby et al. (2022), this thesis argues that health and wellness of social domain does not exist in isolation from ecological domain. Of greater concern is that the deterioration of farmers' physical, mental, and emotional health and well-being could erode household resilience in long-term and have severe implications for rural communities (McNamara, Westoby & Chandra 2021).

Additionally, this research argues that cascading and compounding effects act as risk multiplier and create more risk for future losses. For example, farmers were deeply concerned that the loss of income could lead to cascading impacts that could affect their children's education. The profound concern regarding 'spiralling and intergenerational impacts' was also noted by key stakeholders as a prevalent risk. Previous studies have also highlighted that disruption to children's education could result in devastating consequences on sustaining future livelihoods and the welfare of smallholder communities (Chandra et al. 2017; van der Geest & Warner 2015).

The research findings emphasise the inherent interconnectedness of L&D, NELD, and cascading effects which are deeply embedded in SES. For instance, due to deteriorating ecological conditions, loss of cash crop yield, and loss of income, farmers faced food insecurity issues. Food insecurity issues also had a detrimental effect on farmers' health and well-being. In addition, loss of household income manifested in difficulties in meeting household and farm expenses, buying less food, and cascading impacts such as difficulties in sending children to school. Similar to the findings of Westoby et al. (2022), this thesis argues that if the interdependencies between various categories of L&D and SES goes ignored, this will significantly undermine the sustainability of SES. Therefore, paying particular attention to people's perspectives and local experiences of L&D and the interaction between SES and L&D allows us to comprehensively understand and respond to L&D across social and ecological domains.

The majority of the L&D experienced by the sugar industry could be categorised as unavoided L&D. According to Verheyen & Roderick (2008), unavoided L&D is when L&D could have been avoided through adequate mitigation and adaptation measures but were not implemented due to financial or technical constraints. For instance, the sugarcane communities were unable to avert L&D due to inadequate support from extension officers, lack of formal irrigation systems and access to water pumps, and lack of institutional support and initiatives reaching the remote communities. Similar to this thesis, a study by Remling & Veitayaki (2016) in Gau, Fiji, highlighted that communities are aware of their need to adapt and can do so autonomously. Yet, there are limits to what community can do autonomously and the lack of government support further hinders the community-driven initiatives (Stott & Huq 2014). Therefore, unavoided L&D could be avoided by removing adaptation constraints faced by the sugar industry of Fiji (Figure 8.3).

8.5 Climate change loss and damage governance

Climate change L&D governance is crucial for L&D policy (Thomas & Benjamin 2018a; Wewerinke-Singh & Salili 2019). There is a lack of understanding of how vulnerable countries deal with L&D policymaking because the national scale of policy analysis has been largely overlooked (Calliari & Vanhala 2022). This research examined policies implemented at the national strategic and sub-national levels to avert, minimise, and address L&D in Fiji's

sugar industry. Additionally, this thesis investigated capacity, data availability, adaptation technologies, and climate finance governance for addressing L&D in Fiji's sugar industry.

Fiji's Prime Minister Frank Bainimarama was the President of the United Nations Climate Conference COP 23 (UNFCCC 2017). Fiji is considered a climate champion due to its active role in international climate change discussions. The research findings reveal that at the national strategic level, the Fijian government has climate change and DRR policies, such as Fiji's NCCP and NDRRP, with explicit reference to L&D. The national strategic level policy analysis reveals that L&D is a stand-alone domain as well as a cross-cutting issue with reference to sudden and slow-onset events (Ministry of Economy 2019; The Government of Fiji 2018). However, at the sub-national level, the Ministry of Sugar Industry has been unable to develop climate change and DRR policies and plans and has been unable to mainstream climate change issues into existing policies and plans. Given that L&D discussions have been part of climate change negotiations for more than thirty years (McNamara & Jackson 2019), it is surprising that the sugar industry, formerly the backbone of Fiji's economy, does not have any climate change policy. Even surprising is the fact that Minister of Sugar Industry is Fiji's Prime Minister who has been actively seeking to increase global climate ambition.

The pre-existing policies, such as the Sugar Cane Growers Fund Act, the Sugar Cane Industry Act 1984, the Sugar Research Institute of Fiji Act 2005, and the Master Award, are centred around mill efficiency and maximising production with no consideration of climate change. One reason for the lack of climate change policy would be the lack of staff in the Ministry of Sugar Industry. As mentioned by Stakeholder 16, the Ministry of Sugar Industry has only sixteen staff. Of the sixteen staff, only one staff is engaged with policy development of the sugar industry. From a practical perspective, it becomes difficult for one person to develop and revise policies for the sugar industry. Additionally, this research articulates that there are no climate change experts in the Ministry of Sugar Industry. As highlighted in Chapter 7, due to lack of climate change experts, there is lack of climate change policy and inadequate adaptation measures being implemented under changing climatic conditions. Most of the adaptation measures implemented by the Ministry of Sugar Industry are incremental measures which do not address SES vulnerability resulting in severe L&D.

The lack of climate change policies at the Ministerial level is an example of lack of adaptive governance which undermines the sustainability of the sugar industry. Absence of climate change policy indicates that there is no consideration for future SES vulnerability, impacts, and L&D. Evidently, poor farmers continue to suffer L&D with minimum support at the community level. This leads to a cycle of continuous L&D which farmers find hard to escape. Arguably, the severe L&D faced by Fiji's sugar industry and a lack of adaptive governance will perpetuate risk and lead to the early demise of the sugar industry. The collapse of the sugar industry will have a broader implication for Fiji's economy by producing a cascading and ripple effect which will affect sugar industry employees, farm labourers, and other sectors (Deverall & Lennon 2005; Reddy 2003). Therefore, this research argues that L&D is a concerning issue and the Ministry of Sugar Industry needs to go beyond current practices and develop climate change policies, constructively align to national priorities and sustainable development goals, and coherently address L&D in vulnerable communities. More importantly, learning from the past experiences of sudden and slow-onset events and resulting

L&D will assist in knowledge sharing, developing locally sensitive, culturally appropriate, and evidence-based policies and plans (Stott & Huq 2014; Thomas & Benjamin 2018b).

Moreover, since the sugar industry lacks climate change policy, there are no disaster response plans or SOP to inform the roles of respective stakeholders to effectively respond to disasters and mobilise much-needed resources in the disaster-affected areas. Recent research on impacts of droughts in PICs highlighted that reviewing and updating SOP is crucial for forecasting, monitoring and responding to slow-onset events (Iese et al. 2021). The *ad-hoc* approach to responding to a disaster or a case-by-case approach is unsustainable, resulting in maladaptation, increased SES vulnerability, and L&D (Thomas & Benjamin 2018b). Furthermore, the lack of unsupportive climate change policies is a prioritisation failure of the Ministry of Sugar Industry. It undermines the ability of the industry to seek donor assistance, conduct research and development, and mobilise resources to avert, minimise, and address L&D in vulnerable communities. In line with this thesis, Thomas & Benjamin (2018a), Thomas & Benjamin (2018b), and Thomas & Benjamin (2020) analysed L&D governance and management in the Caribbean and SIDs and highlighted that L&D governance is constrained by lack of L&D policies, by a lack of data, and gaps in financial assessments to avert, minimise, and holistically address L&D.

Empirical evidence reveals that human resource capacity and human resource availability remain a fundamental challenge for addressing L&D in Fiji's sugar industry. Similar challenges such as lack of knowledge and technical expertise have been cited in other vulnerable countries (Klöck & Nunn 2019; Monnereau & Abraham 2013; Shakya et al. 2018; Traore & Owiyo 2013). While lack of staff has been noted in the Ministry of Sugar Industry, the research reveals limited technical staff and extension officers in SRIF. Further exacerbating capacity in SRIF is the lack of climate change training and the lack of formal education on climate change issues. Since climate change is ongoing, extension officers must be well-informed of climate change issues facing vulnerable communities. Yet, lack of staff and technical expertise results in poor farmer outreach, extension officers struggling to advise farmers on climate change issues, access to poor technology, difficulty submitting research proposals, and securing funds for future research. Consequently, rural and remote communities are left on their own to deal with L&D. Hence, key partnerships with local stakeholders such as the Ministry of Agriculture and the Climate Change and International Cooperation Division should play a key role in providing climate change expertise and assist in addressing L&D in Fiji's sugar industry.

Another institutional challenge noted at the sub-national level is the sharing of data. Empirical evidence from this thesis reveals that government ministries prefer to collect data in isolation with very little standardisation. According to Thomas & Benjamin (2018a) and UNDP (2017), the lack of access to appropriate L&D data is a challenge for addressing L&D in vulnerable countries. The lack of standardised data and the unwillingness to share data between government ministries has resulted in difficulties in developing risk profiles, L&D tools and methodologies, difficulties in understanding L&D and adaptation limits, lack of data for attribution and detection, and understanding the extent and cost of L&D. In a recent study, Vanhala, Robertson & Calliari (2021), Thomas & Benjamin (2018a), and Thomas & Benjamin (2018b) highlighted that lack of data acts as a barrier for effective L&D policy formulation.

As Fiji continues to deal with the adverse effects of climate change and L&D, access to international climate finance for addressing L&D is paramount. This study uncovered two concerning issues regarding climate finance. Firstly, the majority of the stakeholders agreed that new and additional climate finance needs to be delivered to the vulnerable countries to address L&D. Evidently, there has been lack of commitment by the developed countries and insufficient funding for L&D (Cui & Huang 2018; Pauw et al. 2018; Sharma-Khushal et al. 2022). Inadequate L&D finance has resulted in difficulties in addressing L&D at the community level. Under changing climatic conditions, adaptation needs and L&D in vulnerable countries will escalate (Nhamo & Nhamo 2016; Schaeffer et al. 2015; UNEP 2018). For example, L&D costs for developing countries are estimated to be around US$400 billion by 2030, rising to US$1-2 trillion by 2050 (Baarsch et al. 2015). As vulnerable communities continue to be disproportionately affected by climate change L&D, urgent support and action, including finance and technical assistance, is required by the vulnerable countries to avert, minimise, and address L&D.

Secondly, this research provides critical insights into Fiji government's climate readiness. In a recent report, the Fijian government highlighted detailed climate-related projects and climate finance priorities across twelve economic sectors, including Fiji's sugar industry, that require funding under increased degree of climate change (Government of the Republic of Fiji 2022). Yet, to be perceived as climate finance ready, national institutions must have adequate knowledge to navigate the complex climate finance environment, have necessary capacity, and robust fiduciary systems (Samuwai & Hills 2018). Evidence from this study reveals that the inability to access climate finance is attributed to lack of capacity, lack of data, poor fiduciary system, and lack of monitoring and reporting system. The lack of climate finance readiness and the absence of an enabling environment are arguably the most profound challenge faced by the Fijian government and have also been highlighted by Samuwai & Hills (2018), Samuwai & Hills (2019) and Hook (2019). Within the context of this study, high vulnerability, poor governance, weak institutional capacity, and poor finance systems leaves vulnerable communities more disadvantaged and marginalised as they continue to suffer devastating L&D.

Finally, the results reveal that the Ministry of Sugar Industry receives limited national domestic finance. The Ministry of Sugar Industry's lack of climate change expertise, lack of policies, and lack of climate change projects is one reason why limited domestic finance is allocated to the industry. Due to these institutional constraints, donors hesitate to allocate finance to the sugar industry. Consequently, limited budget restricts urgent climate action and measures to avert, minimise, and address L&D in the sugar industry. Also, due to limited budget, the Ministry of Sugar Industry cannot hire climate change experts to develop policies and submit research proposals to secure funds. The findings from this research emphasise a cycle of poor governance where 'failure fuels more failure', resulting in enhanced SES vulnerability and L&D. Undeniably, many livelihoods depend on Fiji's sugar industry. Continuing with the *status quo* will result in severe L&D and affect more than one-quarter of the nation's population, deteriorating socio-economic conditions and increasing poverty levels (Reddy 2003). As discussed below, this research reaffirms that urgent policy reforms are required to sustain the sugar industry under changing climatic conditions.

8.6 Policy recommendations for Fiji's sugar industry

The section below offers relevant policy insights, policy entry points, and ways forward for Fiji's sugar industry. The policy priority framework (Figure 8.4) is a simplified version of present-day complexities. Figure 8.4 illustrates policy entry points for Policy Priorities P1 to P4. Additionally, Table 8.1 summarises action and support required at each level (local, sub-national, national, and international levels) to address L&D. Collectively, Figure 8.4 and Table 8.1 are further discussed in Sections 8.6.1 to 8.6.4.

Figure 8.4 demonstrates entry points for Action Items A1 through to A6 which could be implemented simultaneously. These Action Items are considered within Policy Priorities P1 to P4 but are also explicitly captured in the policy priority framework. At each stage, feedback and feedforward mechanisms (indicated by dashed arrows) will guide revision of policies. Feedback from monitoring of appropriate indicators provides information regarding the effectiveness of measures implemented to reduce SES vulnerability and L&D. Use of this feedback can result in proactive planning (feedforward) to lessen future SES vulnerability and L&D. Provided below is description of Action Item A1 to A6.

- **A1:** Hire climate change experts and partner with key stakeholders to develop relevant climate change and L&D policies and SOP
- **A2:** Vulnerability assessment, data sharing, develop risk profiles, climate risk management, developing indicators and monitoring, improve early warning systems, mobilise resources (technical capacity, adaptation technology, and finance), education and awareness, climate outlooks and decision support system, integrate local traditional knowledge and scientific knowledge for CCA and DRR, and seek assistance from SNLD
- **A3:** Consideration of insurance, foster public-private partnership, mobilise resources (technical capacity, adaptation technology, and finance), enhance adaptive capacity of farmers, agricultural extension officers, and government officials, provision of climate outlooks and decision support system, integrate local traditional knowledge and scientific knowledge for CCA and DRR, and build back better
- **A4:** Ensure rural and remote communities receive necessary support to implement adaptation measures, integrate local traditional knowledge and scientific knowledge for CCA and DRR, and climate outlooks and decision support system
- **A5:** provision of climate outlooks and decision support system, innovative taxation, mobilise resources (technical capacity, adaptation technology, and finance), document and quantify L&D, integrate local traditional knowledge and scientific knowledge for CCA and DRR, and seek assistance from SNLD
- **A6:** implement transformational adaptation to address root causes of SES vulnerability (land tenure security, livelihood diversification and sustainable farm management, product diversification), climate outlooks and decision support system, innovative taxation, integrate local traditional knowledge and scientific knowledge for CCA and DRR, and stakeholder support for farmers wanting to exist the sugar industry.

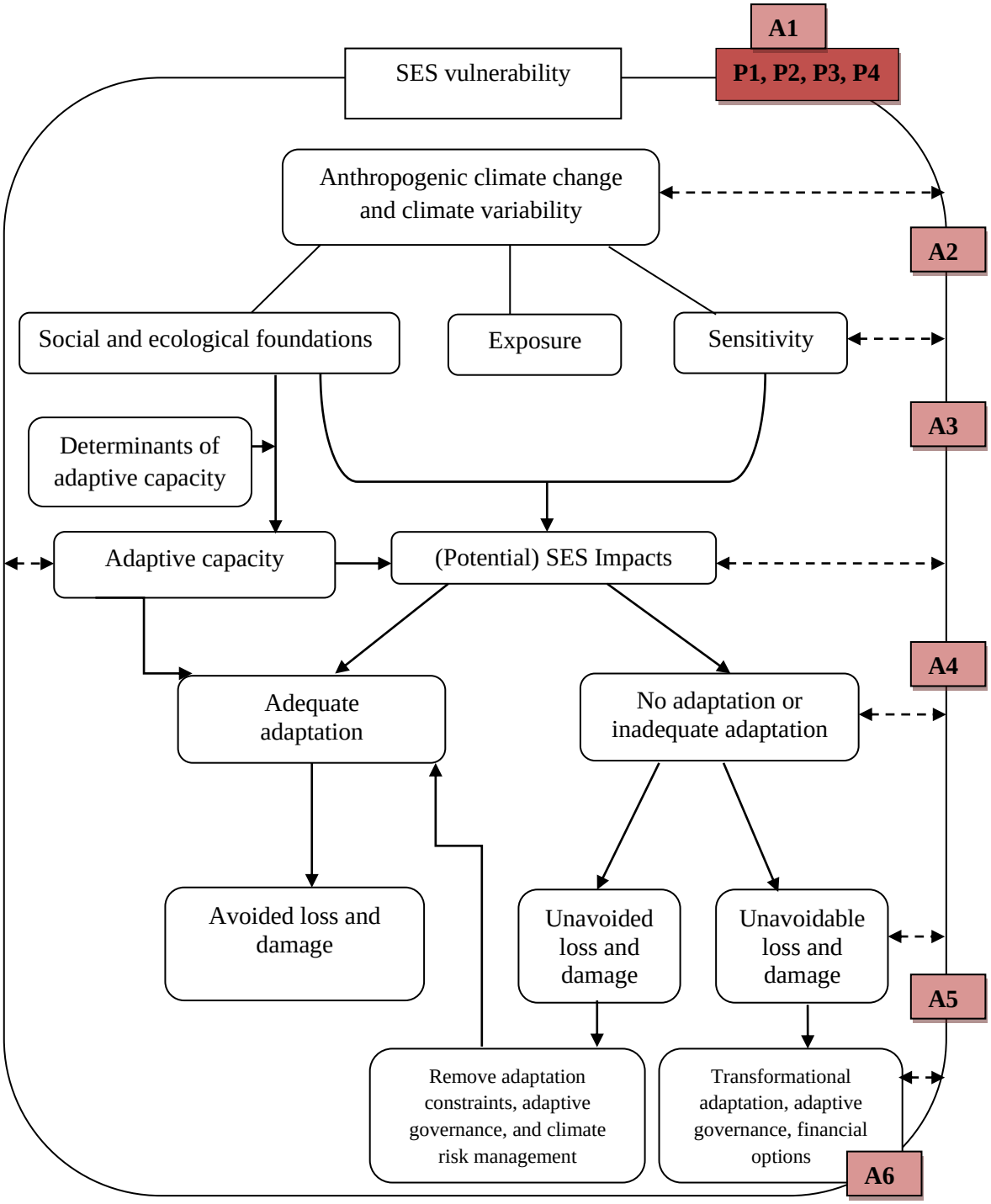

Figure 8.4 Climate change loss and damage policy priority framework

Table 8.1 Summary of action and support required at each level for addressing climate change loss and damage

	Support and action required to address L&D
Local level	Social and ecological transformation (changes in farmers' behaviour, adopting new resilient sugarcane varieties, and sustainable farm management practices), trust and meaningful engagement with extension officers, enhance adaptive capacity of farmers, conduct vulnerability assessment, climate change education and awareness for communities, and integrate local traditional knowledge and scientific knowledge
Sub-national level (Ministry of Sugar Industry)	Conduct vulnerability assessment, develop risk profiles, develop L&D indicators, improve early warning systems and dissemination of disaster alerts, standardised data collection and sharing of data, mobilise resources to communities for climate change adaptation and to address L&D, enhance adaptive capacity of staff through climate change education and awareness for staff, provision of climate outlooks to farmers, use of decision support systems (crop models) to forecast yield and optimise crop management practices, integrate local traditional knowledge and scientific knowledge, consideration of insurance, foster public-private partnership, document experiences and narratives of L&D, develop methods and tools to quantify L&D
National Level	Hire climate change experts, conduct vulnerability assessment, improve early warning systems, partner with key stakeholders to develop relevant climate change and L&D policies and SOP, mobilise resources, standardised data collection and sharing of data, enhance adaptive capacity of staff through climate change education and awareness for staff, integrate local traditional knowledge and scientific knowledge, consideration of insurance, foster public-private partnership, implement innovative finance to address L&D, document experiences and narratives of L&D, develop methods and tools to quantify L&D, ensure there is a L&D focal point to engage with SNLD, and provide support to farmers wanting to exist the sugar industry
International level	Fully operational SNLD (further discussed in Section 8.7)

8.6.1 Policy Priority 1: Unpacking transformational adaptation in Fiji's sugar industry – A response to increasing climate change loss and damage

The IPCC (2014) defined transformational adaptation as adaptation that changes the fundamental attributes of an SES in response to climate and its effects. Many scholars have highlighted that transformational adaptation is not an abrupt or sudden change in SES but rather begins with incremental adaptation and transitions into longer-term adaptation measures in anticipation of future climatic impacts (Deubelli & Mechler 2021; Dharmasiri & Jayarathne 2021; Few et al. 2017; Moser & Ekstrom 2010; Neef et al. 2018; Pelling, O'Brien & Matyas 2015; Rickards & Howden 2012). Recent research in the PICs by Iese et al. (2020) demonstrated how a "step-change" transformational approach increases resilience of farming communities. Similarly, this research argues that transformational adaptation does not necessarily have to be a radical change in SES but non-marginal changes and a continuous

process that nurtures transformational adaptation and is an example of on-going systems co-evolution (Figure 8.2).

Currently, Fiji's sugar industry's performance and sustainability are increasingly questionable due to changing climatic conditions combined with other challenges such as land tenure issues and lack of profitability from sugarcane farming (Dean 2022a; Sami 2020; Singh 2020). To nurture a continuous, non-marginal, and on-going systems co-evolution, integrating social and ecological measures within incremental and systems adaptation strategies would nurture transformational adaptation through a "step-change" process. For example, integrating social and ecological considerations within incremental adaptation would allow transition into systems adaptation and so on (Figure 8.2). Such interventions should reorientate Fiji's sugar industry towards a more sustainable pathway.

To minimise loss of income, livelihood diversification is recommended. Recent research in Fiji's sugar industry has highlighted that sugarcane farmers who engaged in livelihood diversification achieved higher farm profitability than farmers who relied on sugarcane alone (Singh 2020). Livelihood diversification is considered to be the most important adaptation strategy for rural households to maintain survival and resilience by spreading out risk, enhancing social capital, and extending opportunities for overall well-being (Adger et al. 2002; Bousquet et al. 2016; Clissold, Westoby & McNamara 2020; Giannini et al. 2021; Klöck & Nunn 2019). Also, livelihood diversification decreases household vulnerability to climate change because households with several sources of income are more likely to lose a smaller share of their income if one livelihood strategy is affected (Miola et al. 2015).

To prevent degradation of SES, the Ministry of Sugar Industry should promote livelihood diversification with sustainable farm management practices. As documented in Chapter 6, farmers are currently practising unsustainable farming methods. The shift from unsustainable to sustainable farming practices would encourage SES stewardship (Deubelli & Mechler 2021; Rickards & Howden 2012; Vermeulen et al. 2018). For instance, simple social and ecological transformation such as changes in behaviour of sugarcane farmers and reviving sustainable traditional farm practices are critical to ensuring sustainability of SES. Farmers need to be educated on sustainable farm management practices such as intercropping, limited burning of sugarcane fields, sustainable soil management practices, limited use of fertilisers, and agro-forestry.

Additionally, at the community level, facilitating access to new markets for sale of cash crops provides rural households opportunities for trade and income generation. Cultivation of a variety of fruits and vegetables, provision of poultry meat, and honey could provide additional income for sugarcane farmers. Also, increased air services between Fiji, Australia, and New Zealand increases trade opportunities to export locally produced root crops, fruits, and vegetables (Singh 2020). Therefore, engaging in new market opportunities is a crucial adaptation response for rural households (Mearns & Norton 2010). This is because income-generating activities better prepare households for adverse climate events and enable faster recovery by ensuring stable sources of income (Clissold, Westoby & McNamara 2020; McNamara, Clissold & Westoby 2020). At the institutional level, Fiji's sugar industry could scale up efforts to diversify its products and by-products and engage in new market exchange opportunities such as bagasse electricity generation and sugar-based fuel ethanol (Deverall &

Lennon 2005). Similar interventions have been suggested by a recent study on the Fijian sugar industry (Sachan & Krishna 2021).

Furthermore, adopting resilient and early maturing sugarcane varieties could avert and minimise yield loss from cyclones and droughts. Research on resilient sugarcane varieties is a key responsibility of SRIF (Dean 2022b). Yet, research by Mahadevan (2009) on Fiji's sugar industry revealed that 64 percent of farmers were unaware of the newer and improved sugarcane varieties. Therefore, partnership between the Ministry of Sugar Industry and key stakeholders such as SRIF and the Pacific Community's Centre for Pacific Crops and Trees (CePaCT) would strengthen research on resilient varieties and increase farmer consultation on benefits of planting resilient varieties. For example, as stated by Stakeholder 25, farmers should be encouraged to adopt Viwa variety which can act as a shield against severe winds and protect inner rows of sugarcane during cyclones to minimise farm losses. Building on Stakeholder 25, this research emphasises that SRIF and CePaCT could collaboratively research and release more resilient and higher yielding varieties to encourage industry-wide change. While adopting new resilient and higher yielding varieties, farmers need to be given assurance that any farm losses from these new and improved varieties would be compensated by the Fijian government. This would ensure that farmers adopt new varieties and have faith in their government.

Beyond social and ecological transformation, at the heart of the sugar industry is the welfare of sugarcane farmers. Under changing climatic conditions, lack of profit from sugarcane farming, and land tenure issues, the Ministry of Sugar Industry should provide necessary guidance and support if sugarcane farmers want to move out of the sugar industry. Consequently, externally supported structural programs and working with development partners could help to identify future prospects and long-term solutions such as future livelihood and housing prospects (Asian Development Bank 2009; Whitbeck 2006). Additionally, NGOs, religious organisations, and cultural organisations could also provide assistance such as occupational training (Whitbeck 2006). At the international level, the WIM and SNLD must be fully operational and provide much-needed support and action so that vulnerable countries can adapt to adverse climate change impacts and build climate resilience.

8.6.2 Policy Priority 2: Improving adaptive governance in Fiji's sugar industry

Adaptive governance represents a series of structures and processes that allow transformation of an existing environmental regime toward a more flexible regime (reorganisation in governance) (Chaffin & Gunderson 2016; DeCaro et al. 2017). After TC Winston, the Fijian government implemented NCCP and the NDRRP to ensure that Fijian communities transition from a risk to a resilient pathway (The Government of Fiji 2018; Ministry of Economy 2019). The NCCP and the NDRRP are national keystone policies that strengthen disaster risk governance and drive action on climate change and DRR. Recent report by Naivalu et al. (2022) has highlighted that at the sub-national level, several Ministries such as the Ministry of Agriculture, Ministry of Economy, and Ministry of Health and Medical Services have integrated climate change and DRR considerations into their plans.

Regardless, the Ministry of Sugar Industry has been unable to integrate climate change and DRR considerations into their policies and plans. Unsupportive legislations are an obstacle for addressing L&D (Thomas & Benjamin 2018b) and give rise to rigid structures that resist systematic changes and may trigger a system to collapse (DeCaro et al. 2017). Thus, the

Ministry of Sugar Industry needs to ensure that climate change and DRR policies are developed and mainstreamed into existing policies, plans, budgets, and constructively aligned to the national strategic policy goals. Partnership with key stakeholders, knowledge sharing, and hiring a climate change expert or developing a climate change unit is recommended for developing climate change and DRR policies and mainstreaming climate change and DRR issues into sugar industry's pre-existing policies and plans.

Policies and regulatory frameworks must be revised and updated as new information arises (Chaudhury 2015). This would ensure that the Ministry of Sugar Industry moves from a rigid regime to a more flexible and climate-resilient regime to address SES vulnerability and L&D. Just as importantly, updated policies and plans need to filter to the district level so that local governments can support local communities implement adaptation and DRR measures (Ziervogel 2019). For example, the Ministry of Sugar Industry provides irrigation grants during droughts, regardless, both Barotu and Toko settlements were unaware of such initiatives.

Furthermore, the cane payment system which is based on weight payment (instead of sugar content payment), should be revised to promote optimal mill output. As stated by Stakeholder 16, the main reason why farmers do not adopt new sugarcane varieties is because of the weight payment system. The weight payment system does not support adoption of new climate-resistant varieties. Hence, it is essential that the Ministry of Sugar Industry uses evidence-based studies (example, Dean (2022), Lejars et al. (2010), Snell & Prasad (2001), SRIF (2014)) and revise the weight payment system to sugar quality-based payment system and set sector-based quality targets to facilitate optimal mill output.

The revised payment system should encourage adoption of new climate-resilient sugarcane varieties as well as planting a mix of sugarcane varieties. A study in Fiji's sugar industry highlighted that planting a mix of sugarcane varieties such as early maturing, mid maturing, and late-maturing could improve efficiency to achieve optimal sugarcane output (Mahadevan 2009). The Fijian government could also use best practices and lessons learnt from other sugarcane growing regions to design policy measures to reduce cost production, improve mill efficiency, and enhance farm productivity (Deverall & Lennon 2005; Sami 2020).

Additionally, the Ministry of Sugar Industry should provide improved benefits to retain existing and attract new farmers to the sugar industry. Such improved benefits could include access to Fiji's superannuation fund (the Fiji National Provident Fund (FNPF)) and revision in the cane payment system. For instance, the current payment method as set out by the sugar industry's Master Award is unfavourable to smallholder farmers. One harvesting season's payment is distributed as three-five payments over two consecutive sugarcane seasons (Dean 2022a). Also, the sugar industry's Master Award facilitates an inequitable distribution of sugar proceeds to the miller which does not permit sufficient reinvestment in the sugar sector's infrastructure (Narayan & Prasad 2003; Reddy 2003). Consequently, the sugar industry cannot upgrade its deteriorating infrastructure. As a result, due to recent severe cyclones, Fiji's sugar industry has faced severe L&D such as closure of Penang mill (Dean 2022a; Esler 2016; Sami 2020).

Therefore, this research emphasises that in consultation with farmers union and FSC, the Master Award needs to be revised to meet the current needs of the industry. For instance,

regular payments would prepare farmers for adverse events and the next sugarcane growing season. The cane payment system should also contribute towards FNPF securing farmers' future with retirement savings and pre-retirement benefits such as housing, medical, and education assistance. Also, proceeds from product diversification (as recommended in Section 8.6.1) could assist in upgrading of sugar industry infrastructure.

Finally, insecure land tenure is an example of lack of adaptive governance due to which farmers have inequitable access to land for agricultural and livelihood purposes. The expiry of land leases has caused a decline in sugar production by 30 percent (Narayan & Prasad 2003) and have resulted in reduced investments on the farm and constrained adaptive capacity of sugarcane farming communities (Kumari & Nakano 2016; Neef et al. 2018; Pearce et al. 2018; Prasad & Tisdell 2006). Hence, the Ministry of Sugar Industry, the Ministry of Land and Mineral resources, and the *iTaukei* Land Trust Board, in consultation with landowners, should work together and offer farmers secure land tenure and land lease renewal options for agricultural land. Recent study on Fijian sugar industry highlighted that Indo-Fijian farmers preferred a longer-term 99 years land lease after expiry of their initial leases (Dean 2022b). Ongoing land reforms and innovative land tenure interventions should consider emerging climatic risks, promote climate change adaptation policies and projects, and allow farmers to best respond to climate change (Murken & Gornott 2022). Ultimately, more research is required on land tenure issues to recommend sustainable solutions for Indo-Fijian sugarcane communities.

8.6.3 Policy Priority 3: Delivering climate action through climate risk management-Integrating disaster risk reduction and climate change adaptation

Climate risk management or integration of DRR and CCA is a priority for the Fijian government (Naivalu et al. 2022). To avoid emerging risks, the Ministry of Sugar Industry needs to conduct a vulnerability assessment and develop a climate and disaster risk profile for the sugarcane communities. Consolidating information on sugar industry's climate and disaster risk profile would provide better understanding and identification of current and future risks, inform decision-making, identify opportunities to mitigate risks, and reduce SES vulnerability. To develop a climate and disaster risk profile, the Ministry of Sugar Industry requires access to information such as weather and climate information, disaster risks, and data on vulnerability, adaptation, and L&D. Access to these information could be gathered through evidence-based studies and through a coalition of credible and trusted stakeholders such as the Ministry of Agriculture, Ministry of Economy, the Ministry of Rural, Maritime Development and Disaster Management, the Fiji Meteorological Services, and local and international partners. For a coordinated approach, developing a term of reference or an SOP is necessary to identify roles and responsibilities of each stakeholder. As indicated by Stakeholder 16, the Ministry of Sugar Industry lacks SOP, leading to challenges in decision-making and mobilising resources. Consequently, developing SOP and updating policies (as discussed in Section 8.6.2) would strengthen disaster risk governance, institutional preparedness, coordinated disaster response, and disaster recovery (Gero et al. 2012; Government of Fiji 2012).

Data collection in Fiji, particularly after disasters, is conducted in isolation by various humanitarian cluster groups and Ministries with limited data sharing. Therefore, it is recommended that there needs to be a more standardised practise of data gathering, sharing,

and management between stakeholders for urgent climate action. Availability of standardised data would assist in developing L&D indicators, methodology, and tools (UNESCO 2017). Risk-related data on hazards, exposure, vulnerability, and L&D are also necessary for monitoring progress in reducing disaster risks, enhancing climate adaptation, and achieving sustainable development (Dilley & Grasso 2016; Iese et al. 2021, 2020; Jeggle & Boggero 2018; Lamhauge, Lanzi & Agrawala 2013).

Due to emerging risks, it is important to build capacity of sugar industry's stakeholders. For example, capacity building of farmers and agricultural officers could be achieved through formal and informal education (Shakya et al. 2018). For instance, the University of the South Pacific offers Postgraduate Diploma in Climate Change, Master of Science in Climate Change, and short courses in climate change. The agricultural officers could broaden their knowledge and skills in climate change vulnerability and adaptation by enrolling in these courses. More importantly, it is recommended that agro-meteorology courses are developed for agricultural officers. Formal training in agro-meteorology would ensure that stakeholders understand agro-meteorology information and provide necessary agro-meteorological support and advice at the institutional and community levels for decision-making (Iese et al. 2020). Adaptive capacity of farmers could be enhanced through farmer-field schools and mentoring provided by SRIF and the Ministry of Agriculture. It is also essential to enhance community awareness and education on CCA and DRR through awareness sessions and follow-up activities to build resilience.

The findings suggest that improving access to and accuracy of weather forecasts and early warning signals are necessary to reduce vulnerability to cyclones and droughts. Access to timely weather forecasts and early warning signals provides an opportunity to undertake forecast-based or anticipatory actions that enhance disaster preparedness, improve adaptive capacity of communities, reduce vulnerability to climatic stressors, and prevent L&D (Magee et al. 2016; Naivalu et al. 2022). The findings from this research highlight that there is a lack of an early warning system for droughts in the sugar industry. As stipulated by Iese et al. (2021), the lack of an early warning system for droughts in PICs results in the inability to forecast the start and end of droughts. Using empirical evidence from Fiji's drought studies (example, Anshuka et al. (2021b), Rhee & Yang (2018)), the Ministry of Sugar Industry should collaborate with the Ministry of Agriculture, the Ministry of Rural, Maritime Development and Disaster Management, and Fiji Meteorological Services to develop an early warning system and early action system for droughts.

Moreover, prioritising climate-smart agriculture practices are crucial. Integrating climate outlooks into decision support systems such as crop modelling could simulate current and future climate change impacts on sugarcane growth and yield. Using climate outlooks, decision support systems, and geographic information systems could generate risk maps, evaluate crop management practices, suitable sugarcane planting time, and suitability of various sugarcane varieties under different climate scenarios (Iese et al. 2020, 2021; Nand et al. 2016). Accurate crop model simulation at each stage of crop development could improve decision-making, assist in resource mobilisation, reduce losses, and enhance profitability of agricultural crops (Iese et al. 2020; Nand et al. 2016). Dissemination of crop modelling results and provision of user-end specific information, including information in vernacular language, is necessary to reduce risks. For example, it was observed that Toko farmers had a poor

understanding of climate change. Hence, this research recommends that farmer-specific advisory should be provided in vernacular language.

Consequently, maintaining a two-way information flow is essential to build on existing knowledge and trust. For example, two-way information between farmers and agricultural officers could assist in integrating local and scientific knowledge for better disaster preparedness and resilience. As discussed in Section 8.2, the discrepancy between local knowledge and climate model projections emphasises the need to integrate local traditional knowledge and scientific knowledge for CCA and DRR in rural agricultural communities (Gero, Méheux & Dominey-Howes 2011; Guodaar, Bardsley & Suh 2021; Magee et al. 2016). Recent research has shown that integrating local and scientific knowledge is crucial for understanding climatic risks, reducing SES vulnerability, and informing future adaptation measures (Guodaar, Bardsley & Suh 2021; Mercer, Kelman & Dekens 2009; Magee et al. 2016; Nakamura & Kanemasu 2020).

More importantly, explicit inclusion of most vulnerable and socially marginalised groups (women and youths) is crucial for CCA and DRR (Naivalu et al. 2022; UNDRR 2019). Socially marginalised groups are disproportionally vulnerable to risks (Jeggle & Boggero 2018; Mearns & Norton 2010). Therefore, understanding social dimension of risks and L&D is crucial for reducing current and future risks. For example, the research findings indicate that women farmers suffered severe L&D. Evidently, climate change and disaster impacts are not uniform due to differentiated vulnerability (Boyd et al. 2021). Consequently, to reduce vulnerability, exposure, and inequality, needs of different social groups needs to be recognised and provision of timely support is crucial for recovery purposes (Clissold, Westoby & McNamara 2020; Thomas et al. 2018; UNDRR 2019).

To prevent future risks and more comprehensive resilience building, emphasis has been placed on ‘build back better’ approaches in disaster recovery, rehabilitation, and reconstruction (Noy & Edmonds 2016; Kelman 2019; UNDRR 2019). It has been estimated that build back better or stronger reconstruction could reduce disaster-related losses by more than 40 percent (UNDRR 2019). Disasters such as TC Winston presented a critical opportunity for the Ministry of Sugar Industry to integrate build back better measures into existing infrastructure (update building standards and climate-proof infrastructure) as part of medium and long-term recovery. To illustrate this point, the closure of the Penang mill should set an example to rebuild more resilient and less vulnerable structures. At the local level, reconstruction and rehabilitation phase should encourage building back better initiatives such as building stronger houses whereby building more resilient communities (Nichols 2019; Remling & Veitayaki 2016). Recent reports by UNDRR (2019) and Winterford & Gero (2018) highlighted that recognition of risk integration into development planning and building back better at the sub-national level is essential for achieving sustainable development.

At the international level, the WIM and the SNLD have the potential to assist vulnerable countries avert, minimise, and address L&D. The SNLD was established in 2019 to catalyse technical assistance to implement the functions of WIM (Nand & Bardsley 2020). Yet, the SNLD is not fully operational and not resourced to assist vulnerable countries identify their L&D priorities and or provide technical assistance on institutional, legal, socio-economic, and financial barriers that exist for averting, minimising, and addressing L&D (Sharma-Khushal et al. 2022). Therefore, this research highlights that SNLD must be fully operational and

provide technical assistance for L&D needs assessment and strengthen L&D governance in developing countries.

8.6.4 Policy Priority 4: Financial options for addressing loss and damage in Fiji's sugar industry

Access to international financial support is necessary for supporting climate mitigation, climate adaptation initiatives, and addressing L&D and to build SES resilience (De Marez et al. 2022). Based on climate justice argument and polluter pay principle, this research argues that developed countries hold a moral responsibility to provide new and additional funds for addressing L&D. Therefore, the question remains what should be the modality or how should L&D finance be delivered? Recent research has highlighted that GCF has the potential to play an administrative role in L&D finance mechanism (Pill 2022). Yet, many scholars have argued that the GCF is faced with insufficient funds, faces significant delays in the distribution of funds due to its bureaucratic nature, and has a lack of clear mandate on how L&D finance will be allocated under the GCF (Cui & Huang 2018).

Therefore, to explicitly address L&D, this research recommends the establishment of a new dedicated L&D financial facility based on principles of international cooperation, climate justice, and polluter pay principle. The new L&D financial facility should provide new and additional finance for L&D that should be governed separately and easily accessible by vulnerable small island countries and PICs. The establishment and operationalisation of a new L&D finance facility should act as the third pillar of the financial mechanism under the UNFCCC and be able to provide new L&D financial support under Article 9 of the Paris Agreement alongside adaptation and mitigation. Recent research by Carty & Walsh (2022) and Sharma-Khushal et al. (2021) also proposed establishment of new financial facility for L&D with climate justice-oriented governing arrangements. To access multi-lateral climate finance, including L&D finance, the Fijian government needs to strengthen its fiduciary or accounting processes, public finance management, project management cycle, and monitoring and evaluation mechanisms.

In the Pacific region, establishment of the Pacific Catastrophe Risk Assessment and Insurance Initiative (PCRAFI) aims to increase the understanding of hazards and provides funds to governments in time of a disaster. Regardless, many PICs are not part of PCRAFI as the premium is too high and the payout is low (Handmer & Nalau 2019). Many scholars argue that while insurance may provide finance for emergencies, it is not a source of climate finance and does not address L&D comprehensively (Künzel et al. 2017; Nordlander, Pill & Romera 2020; Sharma-Khushal et al. 2022). For example, insurance can finance recovery from extreme events but it is debatable if much of the Fijian L&D, particularly NELD, and L&D due to slow-onset events are insurable (Durand et al. 2016; Nordlander, Pill & Romera 2020). Accordingly, insurance is seen as a way to transfer responsibility from the big emitters to the poor population at risk (Gewirtzman et al. 2018). For instance, insurance creates an additional financial burden on already vulnerable population (Ahmed et al. 2019; Page & Heyward 2017; UNFCCC 2018d; Voigt 2008).

While this research recognises that insurance is not a source of L&D finance, this research recommends that at the national level macro-insurance premiums can be supported by third parties such as public-private partnerships, international financial institutions, and international non-governmental organisations. Similar approaches have been suggested by

Linnerooth-Bayer & Mechler (2007). At the local level, access to financial literacy programmes for farmers is very crucial. Currently, Fiji is trialling a new parametric affordable and accessible insurance product to provide immediate financial relief to vulnerable population, including farmers and fishermen, from tropical cyclones and floods (UNDRR 2021). Hence, this research recommends that while designing insurance products, smart premium support, appropriate pre-determined parametric triggers, and pro-poor approaches need to be considered.

Another financial option to avert, minimise, and address L&D is to foster public-private partnerships. Leveraging-off from private sector is crucial for accelerating and sustaining climate change efforts. Currently, the Fijian government's resources are insufficient to avert, minimise, and address L&D. Therefore, catalysing public-private partnerships could provide secure financial arrangements (Curuki 2019; Linnerooth-Bayer & Mechler 2007) and also provide an opportunity to pool expertise and fill knowledge gaps related to mitigating climate risks. Through public-private partnership, the government benefits by achieving its national priority goals while the private sector can boost its revenue. Using Fiji as a case study, recent research by Samuwai, Hills & Michalena (2019) highlighted that domestic private investment in renewable energy and climate change efforts stimulates many co-benefits such as creating employment, securing well-being, endogenously growing the private sector and improving readiness for renewable energy, and achieving nationally determined contributors. Therefore, this research recommends that creating the right enabling environment is a key prerequisite for private sector investment in Fiji's sugar industry. The right enabling environment would include developing public-private partnerships policies, plans, and frameworks, appropriate project design and management cycle, readily available skilled labour and staff capacity, appropriate infrastructure, and a stable political environment (Curuki 2019).

Additionally, this research recommends that limited national budget should be supplemented by external funds. However, the vast majority (86 percent) of climate finance is delivered as project support while only 1 percent is delivered as general budget support (Atteridge & Canales 2017). Since much of the external aid is delivered outside the national budget, the government struggles to track this finance or guide it to meet national goals. Consequently, there is duplication of work, waste of resources, and it is unclear if the projects meet national priorities. Therefore, it is recommended that there should better tracking and monitoring systems in place. A monitoring process would ensure that the funds delivered outside the national budget could be easily tracked and ensure that these funds meet national priorities.

Moreover, this research recommends development of innovative ex-post finance approaches, such as taxation, for addressing L&D. For example, the Fijian government could introduce carbon tax on deforestation. Similar to the ECAL, the carbon tax will be used to finance climate change projects. The proceeds of carbon tax on deforestation would prevent forest degradation, conserve native forests, reduce emissions from deforestations, restore ecosystem services (flood regulation and soil retention), and increase carbon sequestration. At the sub-national level, the Ministry of Sugar Industry could introduce duty on imported cane sugar which would encourage Fijian businesses to utilise local sugar. Additionally, the Ministry of Sugar Industry could introduce tax on the manufacture and use of synthetic nitrogen fertilisers and pesticides that contribute to GHG emissions. This intervention would encourage farmers to limit use of synthetic chemicals and adopt sustainable farming practises. Recent discourse

on L&D finance has also highlighted the need for innovative finance for addressing L&D. Such innovative L&D finance includes climate damage tax imposed on fossil fuel companies, international airline passenger levy, solidarity levy, and global carbon tax (Carty & Walsh 2022; Roberts et al. 2017; Wewerinke-Singh & Salili 2019).

Finally, Fiji's Ministry of Sugar Industry should create a L&D fund. The L&D fund called Loss and Damage Community Fund would aim to facilitate long-term recovery as well as mobilise funds to priority areas (based on risk profiles developed in Section 8.6.3) for addressing SES vulnerability and to avert, minimise, and address L&D. The Loss and Damage Community Fund would also comprehensively support transformative measures such as relocation. The day-to-day operation of this fund would be run by a Secretariat and the climate change team of the Ministry of Sugar Industry. Additionally, farmers could access these funds in form of grants by writing an Expression of Interest which would be examined and approved by the Secretariat and the Minister of Sugar Industry. The distribution and use of funds at the community level would be guided by regulatory frameworks in place, the Secretariat, and the climate change unit which would provide financial and technical expertise. For ongoing financial support, the Loss and Damage Community Fund could receive financial contributions through a variety of public, private, and philanthropic sources. Additionally, to ensure accountability and transparency, the Ministry of Sugar Industry should develop standard monitoring, reporting, and fiduciary or accounting processes.

8.7 Theoretical contributions

Using qualitative research and policy analysis, this research has made significant theoretical contributions to SES vulnerability, climate adaptation, and L&D scholarship. Social and ecological systems are confronted with intricate and multifaceted climatic risks that result in L&D. Since the majority of adaptation and L&D studies in Fiji have focused on coastal communities and relocation (Charan, Kaur & Singh 2018; McNamara & Buggy 2017; Piggott-McKellar et al. 2019), this thesis aims to fill a significant research gap by examining SES vulnerability, adaptation, and L&D in Fijian agriculture, particularly Fiji's sugar industry. To achieve the research aim, this thesis adopted SES theory to understand SES vulnerability, current adaptation practices with adaptation limits and barriers, and L&D from sudden and slow-onset events in the Fijian sugar industry.

More importantly, the integration of L&D analysis within SES theory provides a framework for enhancing SES resilience. Using empirical evidence, SES theory is used to develop a conceptual L&D framework (Figure 8.3) that integrates SES vulnerability, climate adaptation, L&D, and measures to avert, minimise, and address L&D. Figure 8.3 could be used as a starting point of L&D analysis and contextualised based on different communities. The use of Figure 8.3 would provide coherence in L&D analysis as well as coherence in the lived experiences and narratives from various communities and agencies. This coherence would ensure that the voices of vulnerable communities are heard - paving way for climate justice at the international level. Therefore, as discussed below, explicit understanding of the local social and ecological context allows to embrace systems integrity, complexity of SES, develop better diagnostic tools, and enable development of meaningful L&D responses. The use of SES theory to understand systems vulnerability is becoming increasingly important among researchers because it aims to identify root causes of vulnerability and adaptation needs for sustainability purposes (Pandey & Bardsley 2015; Shabina et al. 2021).

Conventional SES vulnerability assessments in many countries, including Fiji, have highlighted climatic and non-climatic factors contributing to SES vulnerability and identified adaptation options that could mitigate climatic risks (Chandra & Gaganis 2016; Pearce et al. 2018; Shabina et al. 2021). Compared to current mainstream perspectives on vulnerability analysis (see Pearce et al. (2018) and (IPCC 2007a, 2014a)), this thesis goes beyond current practices and has made a significant theoretical contribution to SES theory and vulnerability assessment.

Using empirical evidence, this research argues that at the community level, explicit consideration of ecological and social integrity, cultural traditions, traditional knowledge, and psychological impacts, that is, the current status of SES, referred to in this research as social and ecological foundations, needs to be a key consideration for understanding SES vulnerability in Pacific communities (Figure 8.1). The lack of consideration of social and ecological foundations in vulnerability analysis has been a significant gap in vulnerability studies. Given the connectedness of social and ecological domains, integration of social and ecological foundations in vulnerability analysis could assist in comprehensively understanding the current status of social and ecological health and how it has an impact on exposure, sensitivity, adaptive capacity, potential impacts, adaptation, and L&D (Figure 8.3). Once a vulnerability assessment is conducted, with consideration of social and ecological foundations, it can then be used to identify adequate adaptation measures to reduce future climatic risks.

Evidence from this study indicates that to reduce climatic impacts, four categories of adaptation strategies were implemented in Barotu and Toko settlements. These adaptation interventions included bearing the effects of cyclones and droughts, coping measures (reactive and short-term behavioural changes), incremental adaptation, and systems adaptation. Similar adaptation measures have been documented in other Fijian villages (Currenti et al. 2019; Magee et al. 2016; McNamara & Prasad 2014; Pearce et al. 2018). Accordingly, adaptation measures implemented in the Pacific communities depend on household and institutional adaptive capacity, that is, access to secure land tenure, access to livelihood options, traditional knowledge, access to livelihood assets (financial, physical, and social capital), climate change awareness, and institutional capacity (Warrick et al. 2017).

Due to poor adaptive capacity, most adaptation measures implemented in both settlements were coping and incremental measures. Additionally, both settlements noted erosive adaptation measures and adaptation constraints due to poor adaptive capacity. Lack of support from the Fijian government further marginalised poor farmers, severely affecting their livelihood, income, food security, and health and well-being. Even though households have shown some degree of resilience and the willingness to adapt, government intervention is imperative in the adaptation process (Remling & Veitayaki 2016; Thomas & Benjamin 2020). Collective action in adaptation process could assist in reducing vulnerability and enhance resilience of SES. Also, systematically identifying various levels of adaptation measures implemented in vulnerable communities can advance our understanding of adaptation limits and constraints, L&D, and present opportunities for policy options. An understanding of adaptation limit could assist local communities and government re-evaluate and prioritise adaptation, integrate L&D into adaptation framework and planning as well as incorporate L&D into monitoring and evaluation processes to avert, minimise, and address L&D.

Despite implementing a range of adaptation measures, Fiji's sugar industry suffered severe L&D. While systems adaptation provides some increased benefits, it is still insufficient to avoid L&D. Engaging in sugarcane farming is a way of life for these Indo-Fijian farmers, giving them purpose and defining them as individuals. The L&D in sugarcane field resulted in loss of income and the inability to provide for family's needs, deterioration of way of life and well-being, and future ways of being. Of greater concern is that without government intervention and international cooperation, poor and vulnerable communities are continuing to implement adaptation measures within their capacity and not co-evolve their adaptation measures under an increasing degree of climate change (absence of system co-evolution) (Figure 8.2).

Changing climatic conditions in association with other domestic and external shocks such as land tenure insecurity will lead to collapse of Fiji's sugar industry. Farmers who have been part of the sugar industry for many years would identify the collapse of the sugar industry as a loss of identity, loss of history and cultural heritage, and a loss of way of life. Many farmers have also developed a strong sense of belonging and emotional attachment to the land, their community, and the sugar industry. Hence, turning away from the sugar industry and seeking an alternative livelihood would be a difficult choice to make. Additionally, the expiry of land leases has not only caused a substantial loss of sugarcane farmers but also sugarcane labourers for cultivation, harvesting, and transport of sugarcane- creating a ripple effect in the sugar industry. Not only have many sugarcane farmers lost their main source of livelihood but in most cases, the vacated land is no longer productive resulting in a decline in sugar production (Naidu 2013). Moreover, giving up sugarcane farming, relocation, and seeking alternative livelihood due to land lease expiry once again question farmers' identity and sense of belonging. Evidently, our findings demonstrate that climatic and non-climatic factors are a powerful force that enhances SES vulnerability and fuels L&D, including NELD and cascading effects.

Consequently, farmers are 'just getting by' and are forced to accept L&D. L&D is also a product of differentiated vulnerability as women farmers were more vulnerable to climate change impacts and suffered severe L&D. Evidence of L&D suggests that L&D significantly undermines the sustainability of SES in which culture, identity, and way of life is embedded for the Pacific communities (McNamara, Westoby & Chandra 2021). The severity of L&D experienced suggests that the vulnerable communities are facing experiences well beyond their limits to adaptation (McNamara & Jackson 2019) and are facing social and ecological thresholds (Dow et al. 2013; Preston et al. 2013; Warner and van der Geest 2013). This thesis also highlights that L&D is context-specific and presents itself as a risk multiplier that could materialise into cascading future L&D.

While the IPCC 6th assessment report (IPCC 2022) provides a comprehensive picture of irreversible climate change risks and L&D, however, it is argued that such analysis does not truly capture the nature of L&D in Pacific communities and what L&D means for individuals. Consequently, this research provides evidence-based lived experiences of Pacific communities living with L&D supported by narratives of climate crisis. The gathering of qualitative data through a storytelling manner, which is culturally relevant in the PICs, captures the essence of unavoided and unavoidable L&D experienced by Pacific communities which many scientific reports have largely overlooked. This study also highlights that L&D,

including NELD and associated cascading impacts, are not occurring separately within the SES, but are inherently interconnected in nature and make it very difficult for full recovery to be facilitated.

This research has broader implications for communities already experiencing L&D. For example, in Fiji, 800 coastal communities are in immediate need of relocation due to rising sea levels (Charan, Kaur & Singh 2018; Gharbaoui & Blocher 2016; Moore 2022; Piggott-McKellar et al. 2019). Extreme events such as severe tropical cyclones, intense rainfall, and flash floods further present unprecedented risks in SES (Chandra & Gaganis 2016; Esler 2016; Thomas et al. 2018). Similar experiences of irreversible losses and intolerable risks have been documented in other PICs (Esler 2015; Handmer & Nalau 2019; Talakia 2015). The evidence that vulnerable communities are living with and have accepted severe L&D is not normal and a matter of climate justice. This study's findings are timely because a climate emergency has been declared in the Pacific region. Recently, at the 51st Pacific Island Forum leaders meeting which was held in Suva, Fiji, on 10th July 2022, the Pacific leaders declared a state of "*climate emergency that threatens livelihood, security, and well-being of its people and ecosystems*" as evidence by "*the latest science and the daily lived realities in Pacific communities*" (Pacific Islands Forum Secretariat 2022).

While L&D is a topic of great significance, L&D is not well understood in the PICs. This research aims to inform local communities and decision-makers that the threat from devastating impacts and residual L&D from sudden and slow-onset impacts is real. Of even greater concern is that climate change risks are expected to become more severe in the future (IPCC 2022). Hence, local L&D research such as this aims to raise awareness and inform global policy outcomes in the hope that urgent climate actions will move beyond current deliberations and formulate effective compensatory mechanisms. Effective compensatory mechanisms are required to address L&D because vulnerable PICs have contributed least to anthropogenic climate change and yet are being disproportionately impacted by climate change due to high exposure, high sensitivity, and low adaptive capacity. Compensation could provide support for trauma, fear, and uncertainty through support groups and medical professionals. While compensation could be used to rebuild and repair houses, it is debatable how to compensate for valuable items or belongings lost that do not hold an economic value and how to compensate for intergenerational impacts. Additionally, should compensation be provided for the *status quo* or in consideration of future risks to build resilience?

Additionally, there is an urgent need to define L&D with a set of relevant parameters. An universally agreed definition would assist in collective L&D climate action across local, national, and international levels. At the local level, it is important to understand what does L&D mean for Pacific communities? In the face of increasing climate change and unavoidable L&D, how can vulnerable communities continuously adapt? Consequently, this thesis provides key insights for the need to critically develop a L&D model that incorporates SES vulnerability. This thesis challenges the conventional approaches for examining L&D. Existing literature fails to provide a comprehensive model for examining L&D. For instance, current approaches for examining and understanding L&D do not explicitly consider SES vulnerability (Barnett et al. 2016; McNamara & Jacot Des Combes 2015; Pill 2021). Building on existing L&D literature (see McNamara, Westoby & Chandra 2021; Pill 2021; Warner & Afifi 2014; Westoby et al. 2022), this thesis argues for a more integrated approach for

examining L&D with consideration of SES vulnerability. This thesis addresses this research gap by developing a L&D model that could be used to examine and assess SES vulnerability and L&D (Figure 8.3). Figure 8.3 illustrates a L&D conceptual framework and suggests ways to avert, minimise, and address L&D such as removal of adaptation constraints and transformational adaptation. Figure 8.3 highlights that climate change L&D cannot be explicitly understood without understanding SES vulnerability and L&D research presents an opportunity to address root causes of SES vulnerability.

For instance, to address SES vulnerability and L&D, this research highlights the need for transformational adaptation. Recent research by various scholars have argued that addressing underlying root causes of SES vulnerability would provide opportunities for implementing transformational adaptation (Boyd et al. 2021; Bahadur & Tanner 2014; Deubelli & Mechler 2021; Fedele et al. 2019, 2020; Matyas & Pelling 2015; O'Brien 2012; Pelling 2011; Roberts & Pelling 2019). Adaptation scholarship has emphasised that transformational adaptation is a radical change in SES (Rickards & Howden 2012). This thesis challenges this view and argues that in the context of Fiji's sugar industry and many vulnerable communities, transformational change is not a radical change in SES but a "step-change" approach (Figure 8.2). As shown in Figure 8.2, transformational adaptation begins with coping and extends through systems adaptation to transformational adaptation, an example of systems co-evolution under changing climatic conditions. Therefore, this research highlights that continuous, systematic changes, strategic shifts, use of feedback, and proactive forward-looking adaptation measures are necessary to drive transformation (Figure 8.3). The rationale for implementing transformational adaptation is that transformational adaptation would provide innovative solutions that would reorganise and reorientate SES from the pre-existing unsustainable trajectory onto a sustainable pathway (Few et al. 2017; Pelling 2011; Rickards & Howden 2012).

Apart from transformational adaptation, other policy interventions are required to avert, minimise, and address L&D. These policy interventions include adaptive governance, climate risk management, and mobilisation of climate finance (Section 8.6). Very few L&D studies have focused on adaptive governance and climate risk management as a way to prevent L&D. Through semi-structured interviews and policy analysis, this thesis fills this research gap by emphasising the role of adaptive governance and climate risk management in averting, minimising, and addressing L&D (Chapters 6 and 7). Institutional barriers related to adaptive governance, climate risk management, and mobilisation of climate finance in Fiji's sugar industry have also been highlighted in Chapter 7. Using key findings, a policy priority framework (Figure 8.4) which is currently missing from Fiji's policy landscape, has been developed to guide implementation of relevant policies and action items. Figure 8.4 demonstrates a policy priority framework with Policy Priorities P1 to P4 and Action Items A1 through to A6. Therefore, this thesis challenges the current practices of the Fiji industry and argues that continuing with *status quo*, that is, lack of transformational adaptation, lack of adaptive governance, poor climate risk management, and lack of climate finance will lead to an early demise of the sugar industry.

Using the adaptive cycle, in the context of Fiji's sugar industry, this research highlights that a collapse is not necessary to drive transformation, that is, why should we wait for a collapse to transform? Transforming from a collapse state, including social and ecological limits, will

require more resources. Therefore, transformation, renewal, and reorganisation should occur in every stage of the adaptive cycle through self-regulated learning to ensure sustainability and achieving long-term goals. Using adaptive governance, this thesis highlights that to prevent demise of the sugar industry and to navigate complex patterns of change and uncertainty, it is imperative to develop effective L&D policy with explicit consideration of SES vulnerability, economic L&D, non-economic losses, and cascading effects. Also, it is essential to formalise relevant institutional structures and establish action plans at the national and sub-national levels for urgent climate action. The formulation of policies will assist in assessing, addressing, and monitoring L&D (Thomas & Benjamin 2020). Moreover, in Fiji, there is no standalone L&D policy. While L&D is mentioned in other national policies and legislations, there needs to be a separate L&D policy, given the unavoidable risks Fijian communities face and would continue to face in the future. Additionally, the current vulnerability assessments do not comprehensively consider L&D. Therefore, L&D governance needs to be strengthened at national and sub-national levels so that resources are efficiently mobilised when required. The policy priority framework also demonstrates that all policy priorities (P1 to P4 as discussed in Section 8.6) must be integrated at the vulnerability stage rather than the L&D stage when it is already too late. Although Fijian communities are already experiencing L&D, integrating policy priorities at the beginning of the framework would assist in minimising SES vulnerability, future climatic impacts, and L&D. The policy priority framework could be contextualised to meet the needs of the other sectors such as the Ministry of Agriculture, Ministry of Commerce, Trade, Tourism, and Transport, and the National Disaster Management Office. The Climate Change and International Cooperation Division of the Ministry of Economy could help implement this framework. More importantly, this framework could be integrated with existing policies and plans such as Fiji's Relocation Guidelines to enhance coastal protection for low-lying communities and assist with relocation. At the international level, the Fijian government can use this framework in UNFCCC COP negotiations to demonstrate the Fiji government's climate readiness and seek much-needed assistance, including climate finance, for addressing L&D. Therefore, this thesis provides a stronger narrative for mobilisation of much-needed support and action, including L&D finance, that would aim to deliver climate justice for vulnerable countries disproportionately impacted by climate change and cannot respond accordingly (Colenbrander, Dodman & Mitlin 2018; Huggel et al. 2016; Schinko, Mechler & Hochrainer-Stigler 2019; Toussaint & Blanco 2019; Wallimann-Helmer 2015). Other vulnerable countries could also adopt this the policy framework to highlight their L&D needs. Thus, using the policy priority framework, this thesis strongly advocates for moving from negotiations stage to implementation stage.

The move from negotiation to implementation stage would involve fully implementing WIM's mandates. Since the establishment of WIM in 2013, the WIM has faced criticism for primarily focusing on its first two mandates and neglecting its third mandate which is mandated to mobilise support and action, including climate finance. With no financial arm in place, the L&D financial needs of the vulnerable countries have gone unheard. The delay in implementing the functions of SNLD has also delayed support for L&D. The SNLD was established in 2019 to catalyse technical assistance to implement the functions of WIM. However, the SNLD is not fully operational (Nand & Bardsley 2020; Sharma-Khushal et al. 2022). Although the functions of SNLD are clear, the institutional arrangements, operational

modalities, and institutional structure are very vague, raising concerns about what the SNLD would do and how. Currently, there are very limited peer-reviewed publications on how the functions of SNLD should be carried out. Hence, this research provides guidance on how the functions of SNLD can be implemented to avert, minimise, and address L&D in vulnerable countries.

At the Conference of Parties (COP) 26 in Glasgow, the Glasgow Climate Pack decided that SNLD will be provided with funds to support technical assistance for the implementation of relevant approaches to avert, minimise, and address loss and damage and the body providing secretarial services to SNLD will administer the funds (UNFCCC 2021c). Yet, this outcome only focuses on funding technical assistance and finance to address L&D still remains a key challenge (Schalatek & Roberts 2021). Therefore, it is hoped that in COP 27, dialogues will be initiated to move forward with L&D resource mobilisation, including L&D finance.

Consequently, to fully operationalise SNLD, WIM Executive Committee (ExCom) needs to develop a Terms of Reference (ToR) for a coordinating body which would provide secretariat services to a fit-for-purpose SNLD. Through this, SNLD would be able to carry out its functions, including being accessible, responsive, and proactive in assisting vulnerable countries with their individual L&D needs. This would include providing simplified direct access to demand-driven technical assistance and associated support for finance and capacity building, which is in addition to existing efforts, for L&D needs assessment, measuring L&D, and strengthening L&D governance in developing countries. The ToR should also allow SNLD to engage with donor partners to source and secure commitments for L&D finance, assist in developing funding proposals, and determine appropriate modalities to access L&D finance for addressing L&D.

At the regional level, the SNLD should engage with Council of Regional Organisations in the Pacific such as the Pacific Community to discuss capacity-building initiatives for relevant authorities (example, national governments) to implement policies to have direct access to SNLD resources. At the national level, the SNLD could provide technical assistance and scale up efforts to address L&D under increasing climate change in key priority areas. The Policy Priority Framework (Figure 8.4) could be used to identify priority areas requiring technical assistance and priorities to address L&D. For each identified priority area, the SNLD could provide technical assistance to identify barriers (economic, financial, and institutional) to address L&D, enhance enabling environment to overcome these barriers (developing policies and institutional structures), provide resources (support, action, and engage stakeholders), implement activities to address L&D and reduce SES vulnerability, and conduct monitoring and evaluation. The technical assistance provided should promote social-ecological systems resilience and empower communities with knowledge and skills to drive locally-led sustainable solutions to address L&D themselves. Also, the technical assistance provided should meet L&D needs such as developing L&D policies, L&D data collection, and implementing L&D projects (Huang et al. 2021).

Apparently, L&D governance is an example of dynamic multi-scalar governance which requires engagement at the international, regional, national, and local level L&D focal points. To coordinate activities, the SNLD would require an effective institutional structure and an institutional framework that connects the international, regional, national, and local to ensure that technical support reaches the most vulnerable. The SNLD secretariat, WIM ExCom, and

an advisory board (consisting of equal representation from developed and developing countries) could oversee institutional structure of SNLD. Yet, the lack of international cooperation, particularly from developed countries, has resulted in delayed positive outcomes. Evidently, continuing with the *status quo*, that is, lack of L&D governance is escalating L&D.

Finally, the key research outputs from my PhD research include peer-reviewed articles. The political nature and progress of L&D negotiations captured in Section 2.2 and its policy implications for PICs has been published as a peer-reviewed paper titled *Climate change loss and damage policy implications for Pacific Island Countries* published in the journal of Local Environment. This paper has been cited by Working Group II (WGII) contribution to the IPCC Sixth Assessment Report (AR6) published in February 2022. Recently, I submitted two paper which are under review. The first paper titled *Addressing unavoidable climate change loss and damage: A case study from Fiji's sugar industry* is under consideration in the journal of Climatic Change. This paper highlights that much of that climate change L&D from cyclones faced by Fiji's sugar industry is irreversible and unavoidable, with social and ecological thresholds being reached. Key policy interventions include addressing unavoidable L&D through transformational adaptation, climate risk management, and mobilisation of L&D climate funds. I have also submitted a paper to Regional Environmental Change titled "*Killing you softly*": Climate change loss and damage from droughts. Key insights from Fiji's sugar industry. Additionally, I have submitted a paper to Local Environment on L&D governance titled *Climate change loss and damage governance. Where are we now? A case study from Fiji's sugar industry*. Finally, due to my extensive research on climate change L&D, I have been invited to be a contributing lead author for Chapter 13: Loss and Damage for the Pacific Ocean Climate Crisis Assessment Project.

8.8 Research limitations

Fiji's experience with climate change L&D has been documented in various studies (Charan, Kaur & Singh 2018; Esler 2016; Thomas et al. 2018). While recent research has captured challenges encountered by Fiji's sugar industry (Dean 2022a, 2022b; Sachan & Krishna 2021; Kumari & Nakano 2016), to date, this is the first climate change L&D research on Fiji's sugar industry. Although this study has made crucial contribution to L&D research, certain limitations have been noted in this study.

To begin with, limitations in interview translations were noted. Although the researcher took care while translating interviews from Hindi to English, the researcher encountered challenges as direct translations in some cases were not possible. This is because the structure of sentences in English is different from Hindi. Also, the researcher found it difficult to translate some Hindi terms into English. Therefore, the researcher took extra care while translation was being performed to ensure sufficient depth and detail were captured and the meaning of the testimonies were not changed.

Secondly, due to financial constraints, only two field sites were visited. While Barotu and Toko settlements provided an in-depth insight into SES vulnerability, climate change impacts, and L&D due to cyclones and droughts, the inclusion of more study sites would have provided a more comprehensive understanding of the link between SES vulnerability and climate change L&D. Even though data collection was conducted in only two communities, the majority of farmers provided in-depth responses and did not shy away from sharing their personal experiences.

Interviews with key stakeholders were also conducted. Key stakeholders included officials from the Ministry of Sugar Industry, Ministry of Agriculture, academics, and climate change experts. However, due to COVID-19 pandemic, some stakeholders were not available for an interview, particularly stakeholders involved in COVID response and located in lockdown areas. This reduced the number of interviews conducted at the strategic national, sub-national, and provincial levels.

Finally, another limitation of the study was that interviews with farmers and key stakeholders were not conducted again to fill the missing gaps. Instead, national reports, reports from the FSC and SRIF, on-going research, and journal articles were relied upon for further information. While these sources provided adequate information, these did not explicitly capture participants' perception on L&D from cyclones and drought.

8.9 Future research directions

Future research directions include exploring mixed methods approach for understanding SES vulnerability and L&D. Similar to this study, many research in Fiji on SES vulnerability to climatic events has been qualitative (Currenti et al. 2019; Pearce et al. 2018; Nakamura & Kanemasu 2020). Recent SES vulnerability research by Shabina et al. (2021) used a mixed-method approach to understand flood vulnerability in Waimanu River Catchment, Fiji. The mixed-methods approach, that is, community participation in conjunction with rainfall variability and land-use assessment provided a comprehensive understanding of SES vulnerability and identified which communities were most vulnerable to floods. Therefore, for future research, a mixed-method approach is recommended to evaluate SES vulnerability to climate change with the aim to identify and prioritise sugarcane communities for DRR, CCA, and L&D interventions.

Extending this research to more sugarcane communities, including Fijian communities, would provide means to comprehensively understand L&D. Data collected could be used to develop L&D tools and methodologies for quantifying L&D. Systematically documenting and quantifying L&D, including NELD and cascading impacts, are important to explicitly capture the nature of L&D at the local level and inform international L&D outcomes. Evidence of L&D and the ability to quantify L&D would provide a strong argument for mobilisation of L&D climate finance for addressing L&D.

Additionally, stakeholders from the sugar industry need to be prepared for future climatic changes and L&D. Understanding current and future climate projections, SES vulnerability, and the associated impacts could provide crucial information on adaptation and L&D needs of Fiji's sugar industry. For instance, this research highlighted that some adaptation measures implemented at the community level were erosive and inadequate resulting in severe L&D. Therefore, research on adaptation limits, removal of adaptation barriers, and transformational adaptation are necessary to avert, minimise, and address L&D.

Finally, it will be increasingly crucial for the government to invest in research on mobilising domestic finance for L&D. This would include research on creating an appropriate enabling environment such as implementing relevant policies, plans, and regulatory frameworks, engaging with various stakeholders, and catalysing on public-private partnership. Engaging with multiple stakeholders and catalysing public-private partnerships with also strengthen future L&D research opportunities.

8.10 Conclusion

Climate change L&D presents inevitable and unprecedented risks for vulnerable communities (McNamara, Westoby & Chandra 2021; Roberts et al. 2014; Warner & Afifi 2014). The severity of L&D experienced in vulnerable communities demonstrates that SES are facing social and ecological thresholds and continue to exist precariously between limits of 'safe' and 'unsafe' operating spaces at the adaptation frontier (Dow et al. 2013; Preston et al. 2013; Warner and van der Geest 2013). Recognition of L&D is crucial for L&D policy areas, particularly climate justice. Given this context, this thesis examined SES vulnerability, adaptation measures, and residual L&D from cyclones and droughts in Fiji's sugar industry.

Using SES theory, this research argues that to facilitate adequate adaptation and mechanisms to address L&D, attention must be paid to broader social, economic, and political processes happening at the national, sectoral, and community levels. This research has challenged the conventional approach for understanding L&D in SES. Many scholars have documented L&D without explicitly considering SES vulnerability, that is, elements of exposure, vulnerability, and adaptive capacity (McNamara et al. 2018; Pill 2021). This research argues that L&D cannot be explicitly understood without understanding SES vulnerability. The explicit consideration of SES vulnerability in L&D research aims to address underlying root causes of SES vulnerability. By doing so, L&D research provides an opportunity to engage in transformational adaptation and other innovative solutions that could reorganise and reorientate SES from the pre-existing unsustainable trajectory onto a sustainable pathway.

Additionally, this research revealed that vulnerable communities, such as Barotu and Toko settlements, face unprecedented climatic risks and severe L&D from cyclones and droughts. Fiji's sugar industry implemented adaptation measures which ranged from bearing the effects of cyclones and droughts, reactive coping measures, incremental measures, and systems adaptation. Despite implementing adaptation measures, Fiji's sugar industry faced severe unavoided L&D from droughts and unavoidable L&D from cyclones. The research findings reveal how farmers are 'just getting by' and 'living with' L&D. In addition, L&D documented in this research goes beyond material loss and touches upon people's sentiments and identities that contribute to the functioning of SES. The findings also reveal that L&D, including NELD, are highly context-specific and depends on what people value, how people experience L&D, and how they deal with L&D. From a practical standpoint, the severity of L&D experienced suggests that the communities have approached social and ecological limits and are living with intolerable risks that threaten the sustainability of SES.

At the international level, the current level of action and support, including finance, provided for L&D has been inadequate and a political struggle (Wewerinke-Singh & Salili 2019). Developing countries are experiencing devastating L&D without substantially contributing to the problem themselves and in most cases have the least capacity to respond to the risks (Bodansky 2017; Huggel et al. 2016; Wallimann-Helmer 2015). Essentially, the operationalisation of UNFCCC's WIM and SNLD needs to be accelerated to provide timely assistance to vulnerable countries for implementing approaches to avert, minimise, and address L&D. More crucially, the nature of L&D experienced by vulnerable countries requires urgent mobilisation of resources, including climate finance. Overall, evidence-based L&D studies and systematic documentation of L&D would improve understanding of L&D,

including NELD, and facilitate the mobilisation of urgent support and action required to address L&D in vulnerable communities that lack the capacities to respond independently.

Appendices

Appendix 1 Ethics approval

Our reference 33624

10 May 2019

THE UNIVERSITY of ADELAIDE

RESEARCH SERVICES
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CRICOS Provider Number 00123M

Dr Douglas Bardsley
School of Social Sciences

Dear Dr Bardsley

ETHICS APPROVAL No: H-2019075

PROJECT TITLE: Policy options for climate change loss and damage: A case study from Fijian agriculture

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)* involving no more than low risk for research participants.

You are authorised to commence your research on: 10/05/2019
The ethics expiry date for this project is: 31/05/2022

CONDITIONS OF APPROVAL: Thank you for your responses to the matters raised. The revised ethics application provided on the 9th of May, 2019 has been approved.

NAME INVESTIGATORS
Chief Investigator: Dr Douglas Bardsley

Student – Postgraduate
Doctorate by Research (PHD): Ms Moleen Monita Nand

Associate Investigator: Dr Jungho Suh

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project, proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

Yours sincerely,
Dr Anna Olijnyk
Convenor

Dr Jungho Suh
Convenor

The University of Adelaide

Appendix 2 Interview guide

Semi-structured interview questions for farmers

Protocol:

1. Briefing of research
2. Handing out Participant Information Sheet
3. Briefing on complaint procedure
4. Signing of consent form
5. Begin interview. Audio record interview if permission is granted otherwise, take notes.

Date: **Site:**

Questions:

Section 1: Socio-economic and demographic characteristics to determine vulnerability

1. Can you please introduce yourself, what year were you born and your occupation?
2. How long have you lived here?
3. Is the main source of income for your household from your farm and what is the monthly income?
4. What crops do you plant?
5. Is there any other source of income that you have?
6. How many people are there in your house?
7. Can you describe your house for me- the material your house is made out of and how many rooms?
8. What is your highest level of education?
9. What is the land holding status?
10. Do you have access to basic amenities such as clean water and electricity?
11. How do you think agriculture in your community has changed in the past years?

Questions for sudden events- cyclones:
Section 2: Impact of climate stressor (cyclone) and household responses

1. Where is your house and farm located?
2. How do you know that a cyclone is approaching?
3. Have you noticed any trend in cyclones?
4. How did you cope or prepare your household and your farm when you heard about the cyclone approaching?
5. Did you have any barriers that prevented you from coping? Such as financial barriers or cultural barriers?
6. What kinds of impacts did cyclones have on your house and farm?
7. What do think of the heavy rainfall associated with cyclones? Did this have any impact?

8. What do you think of the storm surge associated with cyclones? Did this have any impact?
9. How severe were these impacts?
10. On average, what percentage of your house and farm were affected?
11. What indirect impacts did you face?
12. How did the cyclones affect your community and how did the community cope?
13. Did you have to seek shelter elsewhere?
14. How did you recover after the cyclone? (aid or family assistance?)
15. Was there any help provided by the local government, the Fijian government or any NGO?
16. How did you respond when the next cyclone came?
17. Has there been any farm diversification or income diversification since the cyclone?
18. Is your farm and house insured?
19. Is there any informal insurance mechanism or compensatory mechanism in your community?
20. In the future, do you think there will be any decision to relocate?
21. Is there anything else that you would like to share?
22. Do you think that the climate is changing?

Section 3: Resulting loss and damage

1. Do you think the coping measures that you implemented were effective? What else could have been done to avoid the impacts?
2. When you heard of the next cyclone approaching, how did you prepare your household and your farm?
3. Did your household and farm still face any impacts?
4. Was there any help provided by the local government or the Fijian government?
5. What do you think the government can or should do to assist farmers?
6. Is there anything else that you would like to add?

Questions for slow-onset events- droughts:

Section 2: Impact of climate stressor (drought) and household responses

1. Have you experienced any long-term drought?
2. Can you describe any changes in the occurrence of drought?
3. How do you know that a drought is approaching?
4. How has a drought affected your household and your farm?
5. How did you adapt your household when you heard about the drought?
6. What measures did you take to adapt to or minimise drought impacts on your farm?
7. How did the lack of rainfall impact your household and your farm?
8. How did the heat associated with the drought impact your household and your farm?
9. How severe were these impacts?
10. On average, what percentage of your house and farm were affected?
11. Did the impact on your house and farm lead to any other impact?
12. How did this drought affect your community?
13. Did you have any barriers that prevented you from adaptation? Such as financial barriers or cultural barriers?

14. How did you recover after the drought?
15. Is your farm and house insured?
16. Was there any help provided by family members?
17. Was there any help provided by the local government or the Fijian government?
18. In the future, do you think there will be any decision to relocate?
19. Is there anything else that you would like to share?

Section 3: Resulting loss and damage

1. Do you think the adaptation measures that you implemented were effective? What else could have been done to avoid the impacts?
2. How do you think future droughts will affect your house/farm/community?
3. Do you think these impacts will be severe?
4. Do you think there will be any help provided by the local government or the Fijian government?
5. What do you think the government can or should do to assist farmers?
6. Is there anything else that you would like to add?

Semi-structured interview questions for key stakeholders

Date: **Site:**

Protocol:

1. Briefing of research
2. Handing out Participant Information Sheet
3. Briefing on complaint procedure
4. Signing of consent form
5. Begin interview. Audio record interview if permission is granted otherwise, take notes.

Questions:

Section 1: **Interviewee's background and current role.**

1. Can you please introduce yourself, your background and your current role?
2. How long have you worked in this role?

Section 2: **Climatic trends**

1. What can you say about the current climatic trends faced by Fiji- has there been any significant change in the rainfall pattern and average temperature?
2. How is the agricultural sector coping or adapting to these trends?

Section 3: **Effective response to the impacts of cyclones and droughts in the agricultural sector**

1. What is your opinion on the preparedness of the community for cyclones and drought?
2. Are there any measures the local communities have taken for severe drought and intense tropical cyclones such as storing seeds?
3. How effective are these measures?

Section 4: **Effectiveness of the current policies and institutional frameworks in Fiji that address adaptation needs of the agricultural sector**

1. How has your organisation helped communities prepare or adapt to cyclones and drought?
2. Would you say your organisation is much better prepared after TC Winston?
3. In your opinion, what are the main challenges to adaptation?
4. What are some challenges that your organisation faces while helping communities adapt or cope?

Section 5: **Key informant's perception of loss and damage**

1. Are there any particular barriers faced by the communities for effective implementation of coping and adaptation measures?
2. How do you think these barriers to adaptation affect the role of the organisation and affect the community?
3. What do you think is the link between coping/adaptation and loss and damage?
4. How would you define loss and damage?

5. Do you think attribution plays a significant role in loss and damage? How do you think we can attribute a cyclone to anthropogenic climate change?
6. How do you think loss and damage affects sustainable development of Fiji?

Section 6: **Current local and national loss and damage measures in place to address loss and damage and government's role in advocating for loss and damage**

1. What are some of the measures your organisation has taken to address loss and damage?
2. How informed are your staff and the community about loss and damage?
3. Do you think disaster risk management plays a crucial role to address loss and damage?

Section 7: **Examples of successful loss and damage projects**

1. Is there currently any method your organisation uses to collect loss and damage data?
2. Are there any examples of successful loss and damage projects?
3. Do you think lack of data related to loss and damage is a barrier to addressing loss and damage at national and international levels?
4. Do you think the impacts from cyclones and droughts can serve as lessons learnt to address the issues of loss and damage?
5. In your opinion, what type of loss and damage policies can enhance finance, human and infrastructural support at national level?
6. How do you think we can address non-economic loss and damage in Fiji?
7. In your opinion, how can we address issues of displace arising from loss and damage?

Section 8: Fijian government response

1. How effective are the current policies to address the impact of cyclones and drought in Fiji?
2. Fiji's National Disaster Management Act (1998) and National Disaster Management Plan (1995) have been under review by the government for some time. Do you think this process is taking too much time and that the time to review documents should be strengthened?
3. What do you think the revised policy should look like?
4. What would you consider some major gaps in the policies?
5. How do you think we can address these gaps?

Section 8: **Intergovernmental action/ regional action to address L&D**

1. Are there any mechanisms in place for the Pacific Island Countries to address loss and damage?

Section 9: **Effectiveness of existing international support such as Green Climate Fund and the process involved**

1. What are the current funding available for loss and damage
2. Do you think existing support provided through the current funding mechanisms such as the Green Climate Fund, Adaptation Fund appropriate for loss and damage

in Fiji?

Section 10: **Global politics of loss and damage and ethics involved in loss and damage (distributive justice/ corrective justice)**

1. Why do you think loss and damage had seen no concrete outcome to date?
2. Can you give me some insight into the international negotiation for loss and damage and how the negotiations have progressed so far?
3. What do you think are some challenges to the progress?
4. Do you think developed countries should compensate for loss and damage? If yes, how?

Section 11: **Other options available to address loss and damage that are best suited for Fiji**

1. Do you think risk insurance and risk transfer measures as a response for loss and damage are appropriate for Fiji?

Section 12: **How to enhance action and support to address loss and damage**

1. Addressing loss and damage still remains a challenge. How can we identify policy options and financial needs for addressing loss and damage?

References

ActionAid 2010, *Loss and damage from climate change: the cost for poor people in developing countries.*, accessed May 31, 2019, from <https://actionaid.org/sites/default/files/loss_and_damage_-_discussion_paper_by_actionaid-_nov_2010.pdf>.

Adger, WN & Barnett, J 2005, 'Compensation for climate change must meet needs', *Nature*, vol. 436.

Adger, WN, Dessai, S, Goulden, M, Hulme, M, Lorenzoni, I, Nelson, DR, Naess, LO, Wolf, J & Wreford, A 2009, 'Are there social limits to adaptation to climate change?', *Climatic Change*, vol. 93, no. 3–4, pp. 335–354.

Adger, WN, Hughes, TP, Folke, C, Carpenter, SR & Rockström, J 2005, 'Social-ecological resilience to coastal disasters', *Planning for Climate Change: A Reader in Green Infrastructure and Sustainable Design for Resilient Cities*, vol. 309, no. August, pp. 151–159.

Adger, WN, Kelly, PM, Winkels, A, Huy, LQ & Locke, C 2002, 'Migration, remittances, livelihood trajectories, and social resilience.', *Ambio*, vol. 31, no. 4, pp. 358–66, accessed from <http://www.ncbi.nlm.nih.gov/pubmed/12174607>.

Agrawala, S, Ota, T, Risbey, J, Hagenstad, M, Smith, J, Van Aalst, M, Koshy, K & Prasad, B 2003, *Development and climate change in Fiji: Focus on coastal mangroves*, accessed August 6, 2019, from <https://www.oecd.org/env/cc/21056315.pdf>.

Ahlborg, H, Ruiz-Mercado, I, Molander, S & Masera, O 2019, 'Bringing technology into social-ecological systems research-Motivations for a socio-technical-ecological systems approach', *Sustainability (Switzerland)*, vol. 11, no. 7, pp. 1–23.

Ahmed, M, Birdsall, N, Bishop, J, Gelb, A, James, C, Jenns, N, Kinsela, K, Lamacchia, F, Ranger, N & Rasagam, G 2019, *Are the Pacific Islands insurable? Challenges and opportunities for disaster risk finance*,.

Akram-Lodhi, AH 1997, 'Structural adjustment and the agrarian question in Fiji', *Journal of Contemporary Asia*, vol. 27, no. 1, pp. 37–57.

Ali, R & Narayan, J 1987, 'The Fiji Sugar Industry: A brief histroy and overview of its structure and operations', *Pacific Economic Bulletin*, vol. 4, no. 2, pp. 13–21.

Allen, MR, Dube, OP, Solecki, W, Aragón-Durand, F, Cramer, W, Humphreys, S, Kainuma, M, Kala, J, Mahowald, N, Mulugetta, Y, Perez, R, Wairiu, M & Zickfeld, K 2018, 'Framing and Context.', in V Masson-Delmotte, P Zhai, HO Pörtner, D Roberts, J Skea, PR Shukla, A Pirani, W Moufouma-Okia, C Péan, R Pidcock, S Connors, JB. Matthews, Y Chen, X Zhou, MI Gomis, E Lonnoy, T Maycock, M Tignor, & T Waterfield (eds), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*, pp. 49–91.

Alshenqeeti, H 2014, 'Interviewing as a data collection method: A critical review', *English Linguistics Research*, vol. 3, no. 1, pp. 39–45.

Anderson, C 2010, 'Presenting and evaluating qualitative research', *American Journal of Pharmaceutical Education*, vol. 74, no. 8, pp. 1–7, accessed from <http://www.ncbi.nlm.nih.gov/pubmed/21179252%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC2987281>.

Anshuka, A, van Ogtrop, FF, Sanderson, D, Thomas, E & Neef, A 2021a, 'Vulnerabilities shape risk perception and influence adaptive strategies to hydro-meteorological hazards: A case study of Indo-Fijian farming communities', *International Journal of Disaster Risk Reduction*, vol. 62, no. March, p. 102401, accessed from <https://doi.org/10.1016/j.ijdrr.2021.102401>.

Anshuka, A, Buzacott, AJV, Vervoort, RW & van Ogtrop, FF 2021b, 'Developing drought index–based forecasts for tropical climates using wavelet neural network: An application in Fiji', *Theoretical and Applied Climatology*, vol. 143, no. 1–2, pp. 557–569.

AOSIS 2008, *Multi-window mechanism to address loss and damage from climate change impacts*, Submission to UNFCCC.

Armour, M, Rivaux, SL & Bell, H 2009, 'Using context to build rigor: Application to two hermeneutic phenomenological studies', *Qualitative Social Work*, vol. 8, no. 1, pp. 101–122.

Asafu-Adjaye, J 2008, 'Factors affecting the adoption of soil conservation measures: A case study of Fijian cane farmers', *Journal of Agricultural and Resource Economics*, vol. 33, no. 1, pp. 99–117.

Asian Development Bank 2009, *Fiji Islands: Alternative livelihoods development project*, Suva, Fiji.

Atkinson, P & Coffey, A 1997, 'Analysing documentary realities.', in D Silverman (ed), *Qualitative research: Theory, method and practice*, Sage, London.

Atteridge, A & Canales, N 2017, *Climate finance in the Pacific: An overview of flows to the region*, accessed from <http://www.nab.vu/sites/default/files/documents/SEI-WP-2017-04-Pacific-climate-finance-flows.pdf>.

Baarsch, F, Lissner, T, Schleussner, C-F, Granadillos, J, Bruin, K de, Perrette, M, Schaeffer, M & Hare, B 2015, *Impacts of low aggregate INDCs ambition*, accessed from <https://oxfamilibrary.openrepository.com/bitstream/handle/10546/582427/rr-impacts-low-aggregate-indcs-ambition-251115-en.pdf;jsessionid=F68E25863CAE4D7D8B285B55C17AFDEB?sequence=1>.

Bacolod, ED 2014, *Fiji 2020 Agriculture Sector Policy Agenda*, Suva, Fiji.

Bahadur, A & Tanner, T 2014, 'Transformational resilience thinking: putting people, power and politics at the heart of urban climate resilience', *Environment & Urbanization*, vol. 26, no. 1, pp. 200–214, accessed July 8, 2019, from <www.sagepublications.com>.

Balarabe, SM, Elisha, I & Dayyabu, M 2017, 'Sugarcane farmers' perception, challenges and response to climate change in Kaduna State, Nigeria', *IOSR Journal of Environmental Science, Toxicology and Food Technology*, vol. 11, no. 03, pp. 25–31.

Bamkin, M, Maynard, S & Goulding, A 2016, 'Grounded theory and ethnography combined. A methodology to study children's intercations on children's mobile libraries', *Journal of Documentation*, vol. 72, no. 2, pp. 214–231.

Bardsley, D & Hugo, GJ 2010, 'Migration and climate change: Examining thresholds of change to guide effective adaptation decision-making', *Population and Environment*, vol. 32, no. 2, pp. 238–262.

Barnett, J 2001, 'Adapting to climate change in Pacific Island countries: The problem of uncertainty', *World Development*, vol. 29, no. 6, pp. 977–993.

Barnett, J 2011, 'Dangerous climate change in the Pacific Islands: Food production and food

security', *Regional Environmental Change*, vol. 11, no. 1, pp. 229–237.

Barnett, J & Campbell, J 2010, 'The trouble with climate change', in *Climate change and Small Island States. Power, Knowledge and the South Pacific*, Taylor & Francis ?, pp. 1–17.

Barnett, J, Tschakert, P, Head, L & Adger, WN 2016, 'A science of loss', *Nature Climate Change*, vol. 6, pp. 976–978.

Baseisei, M, Catanasiga, V, Osborne, J & Ilolahia, S 2019, *Localisation in Fiji: demonstrating change*, FCOSS.

Baxter, P & Jack, S 2008, 'Qualitative case study methodology: Study design and implementation for novice researchers', *The Qualitative Report*, vol. 13, no. 2, pp. 544–559.

Becken, S 2005, 'Harmonising climate change adaptation and mitigation: The case of tourist resorts in Fiji', *Global Environmental Change*, vol. 15, p. 381=393.

Benjamin, L, Thomas, A & Haynes, R 2018, 'An "Islands" COP'? Loss and damage at COP23', *Review of European, Comparative and International Environmental Law*, vol. 27, no. 3, pp. 332–340.

Berkes, F, Colding, J & Folke, C 2001, *Navigating Social-Ecological Systems: Building resilience for complexity and change*, Cambridge University Press, Cambridge, UK.

Berkes, F & Folke, C 1998, *Linking social and ecological systems: Management practices and social mechanisms for building resilience*, Cambridge University Press, Cambridge, UK.

Berno, T 2011, 'Sustainability on a plate: Linking agriculture and food in the Fiji Islands tourism industry.', in RM Torres & JH Momsen (eds), *Tourism and agriculture : New geographies of consumption, production and rural restructuring*, Routledge, pp. 87–103.

Bezuidenhout, CN & Schulze, RE 2006, 'Application of seasonal climate outlooks to forecast sugarcane production in South Africa', *Climate Research*, vol. 30, no. 3, pp. 239–246.

Biagini, B, Bierbaum, R, Stults, M, Dobardzic, S & McNeeley, SM 2014, 'A typology of adaptation actions: A global look at climate adaptation actions financed through the Global Environment Facility', *Global Environmental Change*, vol. 25, no. 1, pp. 97–108, accessed from <http://dx.doi.org/10.1016/j.gloenvcha.2014.01.003>.

Biermann, F & Kim, RE 2020, 'The boundaries of the planetary boundary framework: A critical appraisal of approaches to define a "safe operating space" for humanity', *Annual Review of Environment and Resources*, vol. 45, pp. 497–521.

Biggs, R, Schlüter, M, Biggs, D, Bohensky, EL, Burnsilver, S, Cundill, G, Dakos, V, Daw, TM, Evans, LS, Kotschy, K, Leitch, AM, Meek, C, Quinlan, A, Raudsepp-Hearne, C, Robards, MD, Schoon, ML, Schultz, L & West, PC 2012, 'Toward principles for enhancing the resilience of ecosystem services', *Annual Review of Environment and Resources*, vol. 37, pp. 421–448.

Birk, T 2014, 'Assessing vulnerability to climate change and socioeconomic stressors in the Reef Islands group, Solomon Islands', *Geografisk Tidsskrift-Danish Journal of Geography*, vol. 114, no. 1, pp. 59–75.

Birkmann, J 2011, 'First- and second-order adaptation to natural hazards and extreme events in the context of climate change', *Natural Hazards*, vol. 58, no. 2, pp. 811–840.

Boblin, SL, Ireland, S, Kirkpatrick, H & Robertson, K 2013, 'Using stake's qualitative case

study approach to explore implementation of evidence-based practice', *Qualitative Health Research*, vol. 23, no. 9.

Bodansky, D 2010, 'The Copenhagen Climate Change Conference: A Postmortem', *The American Journal of International Law*, vol. 104, no. 2, pp. 230–240.

Bodansky, D 2017, 'The role of the international court of justice in addressing climate change: Some preliminary reflections', *Arizona State Law Journal*, vol. 49, pp. 689–712.

Boon, E, Goosen, H, van Veldhoven, F & Swart, R 2021, 'Does transformational adaptation require a transformation of climate services?', *Frontiers in Climate*, vol. 3, no. February, pp. 1–7.

Booth, H 1999, *Gender database for agriculture and resource management policies in Pacific Island countries*, FAO.

Bousquet, F, Botta, A, Alinovi, L, Barreteau, O, Bossio, D, Brown, K, Caron, P, D'Errico, M, Declerck, F, Dessard, H, Kautsky, EE, Fabricius, C, Folke, C, Fortmann, L, Hubert, B, Magda, D, Mathevet, R, Norgaard, RB, Quinlan, A & Staver, C 2016, 'Resilience and development: Mobilising for transformation', *Ecology and Society*, vol. 21, no. 3.

Bowen, GA 2009, 'Document analysis as a qualitative research method', *Qualitative Research Journal*, vol. 9, no. 2, pp. 27–40.

Bowman, M & Minas, S 2019, 'Resilience through interlinkage: The Green Climate Fund and climate finance governance', *Climate Policy*, vol. 19, no. 3, pp. 342–353.

Boyd, E, Chaffin, BC, Dorkenoo, K, Jackson, G, Harrington, L, N'Guetta, A, Johansson, EL, Nordlander, L, Paolo De Rosa, S, Raju, E, Scown, M, Soo, J & Stuart-Smith, R 2021, 'Loss and damage from climate change: A new climate justice agenda', *One Earth*, vol. 4, no. 10, pp. 1365–1370.

Boyd, E, James, RA, Jones, RG, Young, HR & Otto, FEL 2017, 'A typology of loss and damage perspectives', *Nature Climate Change*, vol. 7, no. 10, pp. 723–729.

Britten, N 1995, 'Qualitative research: Qualitative interviews in medical research', *BMJ*, vol. 311, pp. 251–253.

Bronen, R 2015, 'Climate-induced community relocations: Using integrated social-ecological assessments to foster adaptation and resilience', *Ecology and Society*, vol. 20, no. 3, accessed May 8, 2019, from <http://dx.doi.org/10.5751/ES-07801-200336>.

Brown, P, Daigneault, A & Gawith, D 2017, 'Climate change and the economic impacts of flooding on Fiji', *Climate and Development*, vol. 9, no. 6, pp. 493–504.

Bryman, A 2012, *Social research methods* Fourth Edi., Oxford University Press.

Buckwell, A, Ware, D, Fleming, C, Smart, JCR, Mackey, B, Nalau, J & Dan, A 2020, 'Social benefit cost analysis of ecosystem-based climate change adaptations: a community-level case study in Tanna Island, Vanuatu', *Climate and Development*, vol. 12, no. 6, pp. 495–510.

Burkett, M 2014, 'Loss and Damage', *Climate Law*, vol. 4, no. 1–2, pp. 119–130.

Burkett, M 2016, 'Reading between the red lines: Loss and damage and the Paris Outcome', *Climate Law*, vol. 6, no. 1–2, pp. 118–129.

Calliari, E & Vanhala, L 2022, 'The "national turn" in climate change loss and damage governance research: Constructing the L&D policy landscape in Tuvalu', *Climate Policy*, vol. 22, no. 2, pp. 184–197.

Cámara-Leret, R, Raes, N, Roehrdanz, P, de Fretes, Y, Heatubun, CD, Roeble, L, Schuiteman, A, van Welzen, PC & Hannah, L 2019, 'Climate change threatens New Guinea's biocultural heritage', *Science Advances*, vol. 5, no. 11.

Carmichael, T & Cunningham, N 2017, 'Theoretical data collection and data analysis with gerunds in a constructivist grounded theory study', *Electronic Journal of Business Research Methods*, vol. 15, no. 2, pp. 59–73.

Carmichael, T & Hadžikadić, M 2019, 'The fundamentals of complex adaptive systems', *Understanding Complex Systems*, no. June, pp. 1–16.

Carrico, AR, Truelove, HB & Williams, NE 2019, 'Social capital and resilience to drought among smallholding farmers in Sri Lanka', *Climatic Change*, vol 155, pp. 195-213.

Carter, SM & Little, M 2007, 'Justifying knowledge, justifying method, taking action: Epistemologies, methodologies, and methods in qualitative research', *Qualitative Health Research*, vol. 17, no. 10, pp. 1316–1329.

Carty, T & Walsh, L 2022, *Footing the bill. Fair finance for loss and damage in an era of escalatingclimate impacts*, Oxford, UK.

Chaffin, BC & Gunderson, LH 2016, 'Emergence, institutionalization and renewal: Rhythms of adaptive governance in complex social-ecological systems', *Journal of Environmental Management*, vol. 165, pp. 81–87.

Chandra, A & Gaganis, P 2016, 'Deconstructing vulnerability and adaptation in a coastal river basin ecosystem: A participatory analysis of flood risk in Nadi, Fiji Islands', *Climate and Development*, vol. 8, no. 3, pp. 256–269.

Chandra, A, McNamara, KE, Dargusch, P, Caspe, AM & Dalabajan, D 2017, 'Gendered vulnerabilities of smallholder farmers to climate change in conflict-prone areas: A case study from Mindanao, Philippines', *Journal of Rural Studies*, vol. 50, pp. 45–59.

Chandra, V V, Hemstock, SL, Mwabonje, ON, De Ramon N'yeurt, A & Woods, J 2018, 'Life cycle assessment of sugarcane growing process in Fiji', *Sugar Tech*, vol. 20, no. 6, pp. 692–699, accessed August 5, 2019, from <https://doi.org/10.1007/s12355-018-0607-1>.

Charan, D, Kaur, M & Singh, P 2018, 'Customary land and climate change induced relocation: A case study of Vunidogoloa Village, Vanua Levu, Fiji', in WL Filho & J Nalau (eds), *Limits to climate change adaptation*, Springer, pp. 345–358.

Charmaz, K 1996, 'Grounded theory', in *Rethinking methods in psychology*, pp. 27–49, accessed July 9, 2019, from <http://www.sxf.uevora.pt/wp-content/uploads/2013/03/Charmaz_1996.pdf>.

Charmaz, K 2006, *Constructing grounded theory. A practical guide through qualitative analysis*, SAGE Publications.

Charmaz, K 2011, 'Grounded theory methods in social justice research', in NK Denzin & Y Lincoln (eds), *The Sage Handbook of Qualitative Research*, pp. 359–375.

Charmaz, K 2012, 'The power and potential of grounded theory', *A Journal of the BSA MedSoc Group*, vol. 6, no. 3, pp. 1–15.

Charmaz, Kathy 2015, 'Grounded theory: Methodology and theory construction', *International Encyclopedia of Social & Behavioral Sciences*, pp. 402–407, accessed July 8, 2019, from <http://dx.doi.org/10.1016/B978-0-08-097086-8.44029-8>.

Charmaz, K 2015, 'Teaching theory construction with initial grounded theory tools: A reflection on lessons and learning', *Qualitative Health Research*, vol. 25, no. 12, pp.

1610–1622.

Charmaz, K 2017, ‘The power of constructivist grounded theory for critical inquiry’, *Qualitative Inquiry*, vol. 23, no. 1, pp. 34–45.

Charmaz, K & Bryant, A 2010, ‘Grounded theory’, in *International Encyclopedia of Education*, pp. 406–411.

Chaston, R, Manley, M, Mangubhai, S, Sokowaqanilotu, E, Lalavanua, W, Bogiva, A, Caginitoba, A, Delai, T, Draniatu, M, Dulunaqio, S, Fox, S, Koroiwaqa, I, Naisilisili, W, Rabukawaqa, A, Ravonoloa, K & Veibi, T 2016, *Impact of tropical cyclone Winston on fisheries-dependent communities in Fiji*, Report No. 03/16. Wildlife Conservation Society, Suva, Fiji.

Chaudhury, M 2015, *A review of climate change impacts, adaptation practices and policies, and relevant institutions in Fiji*, Fiji, accessed August 22, 2019, from <https://www.gcfreadinessprogramme.org/sites/default/files/Review of Climate Change Impacts, Policies and Institutions.pdf>.

Chen, WY, Suzuki, T & Lackner, M 2016, ‘Handbook of climate change mitigation and adaptation, second edition’, in *Handbook of Climate Change Mitigation and Adaptation, Second Edition*, Springer International Publishing, pp. 1–3331.

Chillrud, R 2017, *Resilience theory in climate-based agriculture development projects: Useful framework or popular buzzword?*, accessed from <http://digitalcommons.bard.edu/bcep/11>.

Chiseri-Strater, E 1996, 'Turning in upon Ourselves: Positionality, subjectivity and reflexivity in case study and ethnographic research.' Ethics and Representation in Qualitative Studies of Literacy. National Council of Teachers of English, pp. 115-133.

Ciplet, D, Roberts, JT & Khan, M 2013, ‘The politics of international climate adaptation funding: Justice and divisions in the greenhouse.’, *Global environmental politics*, vol. 13, no. 1, pp. 49–68.

Cleary, M, Hayter, M & Horsfall, J 2012, ‘Data collection and sampling in qualitative research: Does size matter?’, *Journal of Advanced Nursing*, pp. 473–475.

Cliffe, N, Stone, R, Coutts, J, Reardon-Smith, K & Mushtaq, S 2016, ‘Developing the capacity of farmers to understand and apply seasonal climate forecasts through collaborative learning processes’, *Journal of Agricultural Education and Extension*, vol. 22, no. 4, pp. 311–325.

Clissold, R, Westoby, R & McNamara, KE 2020, ‘Women as recovery enablers in the face of disasters in Vanuatu’, *Geoforum*, vol. 113, no. December 2019, pp. 101–110.

Coetzee, C, Van Niekerk, D & Raju, E 2016, ‘Disaster resilience and complex adaptive systems theory’, *Disaster Prevention and Management: An International Journal*, vol. 25, no. 2, pp. 196–211.

Colding, J & Barthel, S 2019, ‘Exploring the social-ecological systems discourse 20 years later’, *Ecology and Society*, vol. 24, no. 1.

Colenbrander, S, Dodman, D & Mitlin, D 2018, ‘Using climate finance to advance climate justice: the politics and practice of channelling resources to the local level’, *Climate Policy*, vol. 18, no. 7, pp. 902–9015.

Colloff, MJ, Gorddard, R, Abel, N, Locatelli, B, Wyborn, C, Butler, JRA, Lavorel, S, van Kerkhoff, L, Meharg, S, Múnera-Roldán, C, Bruley, E, Fedele, G, Wise, RM & Dunlop,

M 2021, ‘Adapting transformation and transforming adaptation to climate change using a pathways approach’, *Environmental Science and Policy*, vol. 124, pp. 163–174.

COP 23 2017, ‘Initiative to develop Pacific Finance and Insurance Products launched with €1 million support from Luxembourg - Cop23’, accessed October 10, 2019, from <https://cop23.com.fj/initiative-develop-pacific-finance-insurance-products-launched-e1-million-support-luxembourg/>.

Corley, KG 2004, ‘Defined by our strategy or our culture? Hierarchical differences in perceptions of organisational identity and change’, *Human Relations*, vol. 57, no. 9, pp. 1145–1177.

Corley, KG & Gioia, DA 2011, ‘Building theory about theory building: What constitutes a theoretical contribution?’, *Academy of Management Review*, vol. 36, no. 1, pp. 12–32.

Cote, M & Nightingale, AJ 2012, ‘Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research’, *Progress in Human Geography*, vol. 36, no. 4, pp. 475–489.

Coyne, IT 1997, ‘Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries?’, *Journal of Advanced Nursing*, vol. 26, pp. 623–630.

Creswell, JW 2009, *Research design: Qualitative and mixed methods approaches.* Fourth Edi., Sage, London.

Creswell, JW 2014, *Research design: Qualitative, quantitative, and mixed method approaches* Fouth Edit., SAGE Publications.

Creswell, JW & Miller, D 2000, ‘Determining validity in qualitative inquiry’, *Theory Into Practice*, vol. 39, no. 3, pp. 124–130.

CSIRO 2011, *Current and future climate of the Fiji Islands*, Suva, Fiji.

Cui, L & Huang, Y 2018, ‘Exploring the schemes for Green Climate Fund financing: International lessons’, *World Development*, vol. 101, pp. 173–187.

Cupchik, G 2001, ‘Constructivist realism: An ontology that encompasses positivist and constructivist approaches to the social sciences’, *Qualitative Social Research* , vol. 2, no. 1.

Currenti, R, Pearce, T, Salabogi, T, Vuli, L, Salabogi, K, Doran, B, Kitson, R & Ford, J 2019, ‘Adaptation to climate change in an interior Pacific Island village: A case study of Nawairuku, Ra, Fiji’, *Human Ecology*, vol. 47, no. 1, pp. 65–80.

Curuki, JS 2019, ‘Will the tide of climate finance turn in our favour? Three essays on accessing and mobilising climate finance in Oceania Post-Paris agreement?’, The University of the South Pacific, PhD Thesis.

Dalglish, SL, Khalid, H & McMahon, SA 2020, ‘Document analysis in health policy research: The READ approach’, *Health Policy and Planning*, vol. 35, no. 10, pp. 1424–1431.

Daly, J, Willis, K, Small, R, Green, J, Welch, N, Kealy, M & Hughes, E 2007, ‘A hierarchy of evidence for assessing qualitative health research’, *Journal of Clinical Epidemiology*, vol. 60, pp. 43–49.

Dean, MRU 2022a, ‘The Fiji sugar industry: Sustainability challenges and the way forward’, *Sugar Tech*, vol. 24, no. 3, pp. 662–678.

Dean, MRU 2022b, ‘Their voice matter: Storying the smallholdersSugarcane farmer perspectives on intensification, diversification, and mechanisation of sugarcane farms in

the Fijian sugar industry', *Journal of Alternative Perspectives in the Social Sciences*, vol. 11, no. 3, pp. 353–392.

DeCaro, DA, Chaffin, BC, Schlager, E, Garmestani, AS & Ruhl, JB 2017, 'Legal and institutional foundations of adaptive environmental governance', *Ecology and Society*, vol. 22, no. 1.

Denzin, NK & Lincoln, Y 2011, 'Introduction: Disciplining the practice of qualitative research', in NK Denzin & Y Lincoln (eds), *The Sage Handbook of Qualitative Research*, Sage, pp. 1–19.

Deo, RC 2011, 'On meteorological droughts in tropical Pacific Islands: Time-series analysis of observed rainfall using Fiji as a case study', *Meteorological Applications*, vol. 18, no. 2, pp. 171–180.

Depietri, Y 2020, 'The social–ecological dimension of vulnerability and risk to natural hazards', *Sustainability Science*, vol. 15, no. 2, pp. 587–604.

Deubelli, TM & Mechler, R 2021, 'Perspectives on transformational change in climate risk management and adaptation', *Environmental Research Letters*, vol. 16, no. 5.

Deverall, E & Lennon, S 2005, *The Fijian sugar industry, investing in sustainable technology.* Fiji.

DFAT 2022, '*Country information report Fiji*' accessed January 5, 2023 from < https://www.dfat.gov.au/sites/default/files/country-information-report-fiji.pdf >.

Dharmasiri, LM & Jayarathne, M 2021, 'Transformational adaptation in agriculture under climate change: A case study in the dry zone of Sri Lanka', *Indonesian Journal of Geography*, vol. 53, no. 1, pp. 254–264.

Dilley, M & Grasso, VF 2016, 'Disaster reduction, loss and damage data, and the post-2015 international policy agenda', *Environmental Science and Policy*, vol. 61, pp. 74–76.

Dow, K, Berkhout, F, Preston, BL, Klein, RJT, Midgley, G & Shaw, MR 2013, 'Limits to adaptation', *Nature Climate Change*, vol. 3, no. 4, pp. 305–307.

Dowd, AM, Marshall, N, Fleming, A, Jakku, E, Gaillard, E & Howden, M 2014, 'The role of networks in transforming Australian agriculture', *Nature Climate Change*, vol. 4, no. 7, pp. 558–563.

Dreher, T & Voyer, M 2014, 'Climate refugees or migrants? Contesting media frames on climate justice in the Pacific', *Environmental Communication*, vol. 9, no. 1, pp. 58–76.

Dumaru, P 2010, 'Community-based adaptation: Enhancing community adaptive capacity in Druadrua Island, Fiji', *Wiley Interdisciplinary Reviews: Climate Change*, vol. 1, no. 5, pp. 751–763.

Duncan, R & Sing, YW 2009, 'Policy dialogue the failure of agricultural policymaking in Fiji', *Pacific Economic Bulletin*, vol. 24, pp. 168–184.

Durand, A, Hoffmeister, V, Weikmans, R, Gewirtzman, J, Natson, S, Huq, S & Roberts, JT 2016, *Financing options for loss and damage: A review and roadmap*, accessed May 28, 2019, from <http://www.die-gdi.de>.

Durand, A & Huq, S 2015, *Defining loss and damage: Key challenges and considerations for developing an operational definition*, accessed May 2, 2019, from <http://www.icccad.net/wp-content/uploads/2015/08/Defininglossanddamage-Final.pdf>.

Durant-Law, G 2005, 'Soft systems methodology and grounded theory combined-A knowledge management research approach.', *Online Journal of Knowledge Management*, vol. 2, no. 1, pp. 26–27.

Dworkin, SL 2012, 'Sample size policy for qualitative studies using in-depth interviews', *Archives of Sexual Behavior*, vol. 41, no. 6, pp. 1319–1320.

Erickson, F 2011, 'A history of qualitative inquiry in socila and educational research', in NK Denzin & Y Lincoln (eds), *The Sage Handbook of Qualitative Research*, Sage, pp. 43–49.

Esler, S 2015, *Post-disaster needs assessment. Tropical cyclone Pam, 2015*, Vanuatu.

Esler, S 2016, *Post-disaster needs assessment. Tropical Cyclone Winston, February 20, 2016.*, Suva, Fiji.

Everingham, YL, Muchow, RC, Stone, RC, Inman-Bamber, NG, Singels, A & Bezuidenhout, CN 2002, 'Enhanced risk management and decision-making capability across the sugarcane industry value chain based on seasonal climate forecasts', *Agricultural Systems*, vol. 74, no. 3, pp. 459–477.

Falco, S Di & Sharma-Khushal, S 2019, 'Cognitive drivers, and the effect of information on climate change adaptive behaviour in Fiji Islands', *Environmental Science and Policy*, vol. 92, pp. 245–254.

Falzon, D & Batur, P 2018, 'Lost and damage: Environmental racism, climate justice and conflict in the Pacific', in P Batur & J Feagin (eds), *Handbook of Sociology of Racialand Ethnic Relations*, Springer International Publishing.

FAO 2012a, *Pacific multi-country CPF Document 2013-2017*, accessed August 6, 2019, from <http://www.fao.org/3/a-az134e.pdf>.

FAO 2012b, *Post disaster damage, loss and needs assessment in agriculture*, accessed from <http://www.fao.org/docrep/015/an544e/an544e00.pdf>.

Farbotko, C & Lazrus, H 2012, 'The first climate refugees? Contesting global narratives of climate change in Tuvalu', *Global Environmental Change,*, vol. 22, no. 2, pp. 382–390.

Fath, BD, Dean, CA & Katzmair, H 2015, 'Navigating the adaptive cycle: An approach to managing the resilience of social systems', *Ecology and Society*, vol. 20, no. 2.

FDB 2020, 'Climate and eco-finance', accessed August 15, 2022, from <https://www.fdb.com.fj/climateandecofinance/>.

Fedele, G, Donatti, CI, Harvey, CA, Hannah, L & Hole, DG 2019, 'Transformative adaptation to climate change for sustainable social-ecological systems', *Environmental Science and Policy*, vol. 101, no. August, pp. 116–125.

Fedele, G, Donatti, CI, Harvey, CA, Hannah, L & Hole, DG 2020, 'Limited use of transformative adaptation in response to social-ecological', *Ecology*, vol. 25, no. 1.

Feresi, J, Kenny, G, de Wet, N, Limalevu, L, Bhusan, J & Ratukalou, I 2000, *Climate change vulnerability and adaptation assessment for Fiji*, accessed from <http://lrd.spc.int/pubs/doc_download/1165-climate-change-vulnerability-and-adaptation-assessment-for-fiji->.

Few, R, Morchain, D, Spear, D, Mensah, A & Bendapudi, R 2017, 'Transformation, adaptation and development: relating concepts to practice', *Palgrave Communications*, vol. 3, no. 1, pp. 1–9.

Fiji Government 2019a, 'Agriculture', accessed August 6, 2019, from <http://www.commonwealthofnations.org/sectors-fiji/business/agriculture/>.

Fiji Government 2019b, 'Drought responses report tops disaster meeting', accessed August 21, 2019, from <https://www.fiji.gov.fj/Media-Centre/News/DROUGHT-RESPONSE-REPORT-TOPS-DISASTER-MEETING>.

Fiji Meteorological Service 2006, 'The climate of Fiji', *Information Sheet No. 35*, p. 3, accessed from <http://www.met.gov.fj/ClimateofFiji.pdf>.

Fiji Meteorological Services 2021, 'Fiji sugarcane climate outlook', accessed May 11, 2022, from <https://www.met.gov.fj/aifs_prods/Climate_Products/July 2021sugarOut2021.07.29 13.25.49.pdf>.

FijiSun 2019, '12,500 sugarcane farmers covered under new microinsurance package, FijiCare', accessed October 10, 2019, from <https://fijisun.com.fj/2017/11/26/12500-sugarcane-farmers-covered-under-new-microinsurance-package-fijicare/>.

Finau, G, Tarai, J, Varea, R, Titifanue, J, Kant, R & Cox, J 2018, 'Social media and disaster communication: A case study of Cyclone Winston', *Pacific Journalism Review*, vol. 24, no. 1, pp. 123–137.

Fisher, PB 2011, 'Climate change and human security in Tuvalu', *Global Change, Peace and Security*, vol. 23, no. 3, pp. 293–313.

Fleming, A & Vanclay, F 2010, 'Farmer responses to climate change and sustainable agriculture. A review', *Agronomy for Sustainable Development*, vol. 30, no. 1, pp. 11–19.

Fletcher, SM, Thiessen, J, Gero, A, Rumsey, M, Kuruppu, N & Willetts, J 2013, 'Traditional coping strategies and disaster response: Examples from the South Pacific region', *Journal of Environmental and Public Health*, vol. 2013, pp. 1–9.

Flyvberg, B 2011, 'Case study', in NK Denzin & Y Lincoln (eds), *The SAGE handbook of qualitative data analysis*, Sage, pp. 301–316.

Folke, C 2006, 'Resilience: The emergence of a perspective for social-ecological systems analyses', *Global Environmental Change*, vol. 16, no. 3, pp. 253–267.

Folke, C 2007, 'Social-ecological systems and adaptive governance of the commons', *Ecological Research*, vol. 22, no. 1, pp. 14–15.

Folke, C, Biggs, R, Norström, A V., Reyers, B & Rockström, J 2016, 'Social-ecological resilience and biosphere-based sustainability science', *Ecology and Society*, vol. 21, no. 3.

Fossey, E, Harvey, C, Mcdermott, F & Davidson, L 2002, 'Understanding and evaluating qualitative research', *Australian and New Zealand Journal of Psychiatry*, vol. 36, pp. 717–732.

Fridahl, M & Linnér, BO 2016, 'Perspectives on the Green Climate Fund: Possible compromises on capitalization and balanced allocation', *Climate and Development*, vol. 8, no. 2, pp. 105–109.

FSC 2004, 'FSC Stakeholders', accessed May 4, 2021, from <http://www.fsc.com.fj/stakeholders.html>.

FSC 2012, *FSC Annual Report 2012*, Fiji.

FSC 2013, *FSC Annual Report 2013*, Fiji.

FSC 2015, *FSC Annual Report 2015*, Fiji.

FSC 2016, *FSC Annual Report 2016*, Fiji.

FSC 2020, *FSC Annual Report 2020*, accessed from <http://marefateadyan.nashriyat.ir/node/150>.

FSC 2021, 'Fiji Sugar Corporation', accessed May 4, 2021, from <https://www.sugarsoffiji.com/our-history-management>.

Gani, A 1999, 'Drought, the Asian crisis and Fiji's monetary policy response', *Pacific Economic Bulletin*, vol. 14, no. 2, pp. 110–122.

Gani, A & Scrimgeour, F 2019, 'Trade, agriculture and inter-industry spillover effects in Fiji', *The Journal of Developing Areas*, vol. 53, no. 4, pp. 193–206.

Gardner, A, Fedoruk, M & McCutcheon, H 2012, 'Discovering constructivist grounded theory's fit and relevance to researching contemporary mental health nursing practice', *Australian Journal of Advanced Nursing*, vol. 30, no. 2, pp. 66–74.

Gawith, D, Daigneault, A & Brown, P 2016, 'Does community resilience mitigate loss and damage from climate related disasters? Evidence based on survey data', *Journal of Environmental Planning and Management*, vol. 59, no. 12, pp. 2102–2123.

GCF 2011, *Governing Instrument for the Green Climate Fund*, GCF website.

GCF 2019a, 'About the Fund. Green Climate Fund', accessed October 9, 2019, from <https://www.greenclimate.fund/who-we-are/about-the-fund>.

GCF 2019b, 'Green Climate Fund', accessed October 2, 2019, from <https://www.greenclimate.fund/who-we-are/about-the-fund>.

GCF 2021, 'Areas of work', accessed February 10, 2021, from <https://www.greenclimate.fund/themes>.

van der Geest, K, De Sherbinin, A, Kienberger, S, Zommers, Z, Sitati, A, Roberts, E & James, R 2019a, 'The impacts of climate change on ecosystem services and resulting loss and damage to people and the society', in *Loss and damage from climate change. Concepts, methods and policy options*, pp. 221–236.

van der Geest, K, De Sherbinin, A, Kienberger, S, Zommers, Z, Sitati, A, Roberts, E & James, R 2019b, 'The impact of climate change on ecosystem services and resulting losses and damages to people and society', in R Mechler, L. M Bouwer, T Schinko, S Surminski, J Linnerooth-Bayer, & JoAnne Linnerooth-Bayer (eds), *Loss and damge from climate change. Concepts, methods and policy options*, SpringerOpen, pp. 221–236.

van der Geest, K & Warner, K 2015a, 'Vulnerability, Coping and Loss and Damage from Climate Events', in *Hazards, Risks and, Disasters in Society*, Elsevier Inc., pp. 121–144.

van der Geest, K & Warner, K 2015b, 'Vulnerability, coping and loss and damage from climate events', in A Collins (ed), *Hazards, Risks and, Disasters in Society*, Elsevier, pp. 121–144.

GEF 2012, *Pacific adaptation to climate change. Fiji Islands*, accessed August 6, 2019, from <https://www.sprep.org/attachments/Climate_Change/PACC_Report_of_in-country_consultations_Fiji.pdf>.

Gero, A, Méheux, K & Dominey-Howes, D 2011, 'Integrating community based disaster risk reduction and climate change adaptation: Examples from the Pacific', *Hazards Earth Systems Science*, vol. 11, pp. 101–113.

Gero, A, Méheux, K, Dominey-Howes, D & Heux, KM 2011, 'Integrating disaster risk reduction and climate change adaptation in the Pacific', *Climate and Development*, vol. 3, no. 4, pp. 310–327.

Gero, A, Willetts, J, Daly, J, Buchan, J, Rumsey, M, Fletcher, S & Kuruppu, N 2012, *Background review: Disaster response systems of four Pacific Island Countries*, The Institute for Sustainable Futures.

Gewirtzman, J, Natson, S, Richards, JA, Hoffmeister, V, Durand, A, Weikmans, R, Huq, S & Roberts, JT 2018, 'Financing loss and damage: Reviewing options under the Warsaw International Mechanism', *Climate Policy*, vol. 18, no. 8, pp. 1076–1086.

Gharbaoui, D & Blocher, J 2016, 'The reason land matters: Relocation as adaptation to climate change in Fiji Islands', in A Milan, B Schraven, K Warner, & N Cascone (eds), *Migration, Risk Management and Climate Change: Evidence and Policy Responses*, Springer, pp. 149–173.

Giannini, A, Ilboudo Nébié, EK, Ba, D & Ndiaye, O 2021, 'Livelihood strategies shape vulnerability of households' food security to climate in Senegal', *Frontiers in Climate*, vol. 3, no. November, pp. 1–14.

Gilmore, A & Carson, D 1996, 'Integrative qualitative methods in a services', *Marketing Intelligence & Planning*, vol. 14, no. 6, pp. 21–26.

Gioia, DA, Corley, KG & Hamilton, AL 2012, 'Seeking qualitative rigor in inductive research: Notes on the Gioia methodology', *Organizational Research Methods*, vol. 16, no. 1, pp. 15–31.

GIZ 2015, 'Comprehensive climate risk management', Suva, Fiji.

Glaser, B & Strauss, A 1967, *The discovery of grounded theory. Strategies for qualitative research*, Aldine.

Glaser, BG & Holton, J 2004, 'Remodeling grounded theory', *Qualitative Social Research*, vol. 5, no. 2, pp. 1–22.

Gomez-Echeverri, Luis 2013, 'The changing geopolitics of climate change finance', *Climate Policy*, vol. 13, no. 5, pp. 632–648.

Goulding, C 2003, 'Grounded theory, ethnography and phenomenology. A comparative analysis of three qualitative strategies for marketing research', *European Journal of Marketing*, vol. 39, pp. 294–308.

Gounder, R 2007, 'Strengthening Fiji's national poverty policies in the context of regionalism', *Pacific Economic Bulletin*, vol. 22, no. 2, pp. 91–103.

Government of Fiji 2012, *Post-disaster needs assessment. Tropical Cyclone Evan, 17th December 2012*, Fiji.

Government of Fiji 2013, *Republic of Fiji second national communication to the United Nations Framework Convention on Climate Change*, accessed August 13, 2019, from <https://unfccc.int/resource/docs/natc/fjinc2.pdf>.

Government of Fiji 2017, 'Fiji's Green Bond launch sees unprecedented support', accessed October 9, 2019, from <https://www.fiji.gov.fj/Media-Centre/News/FIJI'S-GREEN-BOND-LAUNCH-SEES-UNPRECEDENTED-SUPPOR>.

Government of Fiji 2018, *Fiji Sovereign Green Bond*, Suva, Fiji.

Government of Fiji 2019, *ECAL in action. How your Environment and Climate Adaptation*

Levy is building a better, stronger Fiji, Suva, Fiji.

Government of the Republic of Fiji 2018, *Republic of Fiji National Adaptation Plan. A path towards climate resilience*, Suva, Fiji.

Government of the Republic of Fiji 2022, *Fiji national climate finance strategy*, Suva, Fiji.

Gsottbauer, E, Gampfer, R, Bernold, E & Delas, AM 2018, 'Broadening the scope of loss and damage to legal liability: An experiment', *Climate Policy*, vol. 18, no. 5, pp. 600–611.

Guest, G, Bunce, A & Johnson, L 2006, 'How many interviews are enough? An experiment with data saturation and variability', *Field Methods*, vol. 18, no. 1, pp. 59–82.

Gunderson, LH 2001, 'Managing surprising ecosystems in southern Florida', *Ecological Economics*, vol. 37, no. 3, pp. 371–378.

Guodaar, L, Bardsley, DK & Suh, J 2021, 'Integrating local perceptions with scientific evidence to understand climate change variability in northern Ghana: A mixed-methods approach', *Applied Geography*, vol. 130, no. July 2020, p. 102440.

Guyatt, D 2017, *First pursuing climate justice within environmental, social and governance investment frameworks*, accessed from <https://www.imf.org/external/pubs/ft/fandd/2012/09/pdf/dervis.pdf>.

Haas, PM & Haas, EB 2002, 'Pragmatic constructivism and the study of international institutions', *Millennium: Journal of International Studies*, vol. 31, no. 3, pp. 573–601.

Hadarits, M, Pittman, J, Corkal, D, Hill, H, Bruce, K & Howard, A 2017, 'The interplay between incremental, transitional, and transformational adaptation: a case study of Canadian agriculture', *Regional Environmental Change*, vol. 17, no. 5, pp. 1515–1525.

Handmer, J & Iveson, H 2017, 'Cyclone pam in Cyclone pam in Vanuatu: Learning from the low death toll', *Australian Journal of Emergency Management*, vol. 32, no. 2, pp. 60–65.

Handmer, J & Nalau, J 2019, 'Understanding loss and damage in Pacific Small Island Developing States', in R Mechler, LM Bouwer, T Schinko, S Surminski, & J Linnerooth-Bayer (eds), *Loss and damge from climate change. Concepts, methods and policy options*, SpringerOpen, pp. 365–380.

Harrington, LJ & Otto, FEL 2019, 'Attributable damage liability in a non-linear climate', *Climatic Change*, vol. 153, no. 1–2, pp. 15–20.

Harrison, H, Birks, M, Franklin, R & Mills, J 2017, 'Case study research: Foundations and methodological orientations', *Forum Qualitative Sozialforschung*, vol. 18, no. 1.

Hirsch, T, Minninger, S, Wirsching, S, Toroitich, I, Cedillo, E, Hermans, M, M, O, Kassa, E, Torikul, H & Ahmen, E 2017, *Non-economic loss And damage with case examples from Tanzania, Ethiopia*, Berlin, Germany, accessed from <www.brot-fuer-die-welt.de>.

van den Homberg, M & McQuistan, C 2019, 'Technology for climate justice: A reporting framework for loss and damage as part of key global agreements', in *Loss and damage from climate change. Concepts, methods and policy options*, pp. 513–545.

Holmes, AGD 2020, 'Researcher positionality: A consideration of its influence and place in qualitative research', *Shanlax International Journal of Education*, vol. 8, no. 4, pp. 1–10.

Hone, P, Haszler, H & Natasiwai, T 2008, 'Agricultural supply response in Fiji', in *Australian Agricultural and Resource Economics Society*, Canberra, accessed August 5, 2019, from <https://tind-customer-agecon.s3.amazonaws.com/ca917506-1531-4409-b84e-62a4223e1ef9?response-content-disposition=inline%3B filename%2A%3DUTF-

8%27%27cp08ho01.pdf&response-content-type=application%2Fpdf&AWSAccessKeyId=AKIAXL7W7Q3XHXDVDQYS&Expires=1564990218&>.

Hook, S 2019, *Pacific experiences on working on accreditation for the Green Climate Fund and the Adaptation Fund*, Suva, Fiji.

Huang, J, Wenger, C, Firm, WL & Guilanpour, K 2021, *Loss and damage: Issues for Cop 26*, Center for climate and energy solutions.

Huggel, C, Stone, D, Eicken, H & Hansen, G 2015, 'Potential and limitations of the attribution of climate change impacts for informing loss and damage discussions and policies', *Climatic Change*, vol. 133, pp. 453–467.

Huggel, C, Wallimann-Helmer, I, Stone, D & Cramer, W 2016, 'Reconciling justice and attribution research to advance climate policy', *Nature Climate Change*, vol. 6, no. 10, pp. 901–908, accessed from <http://dx.doi.org/10.1038/nclimate3104>.

Hunt, W, Vanclay, F, Birch, C, Coutts, J & Flittner, N 2014, 'Agricultural extension: Building capacity and resilience in rural industries and communities', *Rural Society*, vol. 20, no. 2, pp. 112–127.

Huq, S 2016, 'Why the UN's Green Climate Fund is not fit for purpose', accessed October 2, 2019, from <https://www.climatechangenews.com/2016/12/01/why-the-uns-green-climate-fund-is-not-fit-for-purpose/>.

Huq, S, Roberts, E & Fenton, A 2013, 'Loss and damage', *Nature*, vol. 3, pp. 947–949.

van Huysen, T, Hansen, J & Tall, A 2018, 'Scaling up climate services for smallholder farmers: Learning from practice', *Climate Risk Management*, vol. 22, no. October, pp. 1–3.

Iese, V, Halavatau, S, De Ramon N'Yeurt, A, Wairiu, M, Holland, E, Dean, A, Veisa, F, Patolo, S, Havea, R, Bosenaqali, S & Navunicagi, O 2020, 'Agriculture under a changing climate', in L Kumar (ed), *Climate change and impacts in the Pacific*, Springer, Armidale, NSW, Australia, pp. 323–357.

Iese, V, Kiem, AS, Mariner, A & Malsale, P 2021, 'Historical and future drought impacts in the Pacific islands and atolls', *Climatic Change*, vol. 166, no. 19, pp. 1–24.

IFC 2017, 'A Green Bond to help Fiji secure a greener future', accessed October 9, 2019, from <https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/cm-stories/fiji-green-bond-for-a-greener-future>.

Ingold, T 2017, 'Anthropology contra ethnography', *Journal of Ethnography Theory*, vol. 7, no. 1, pp. 21–26.

IPCC 2007a, *Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* ML Parry, OF Canziani, JP Palutikof, L van de, & CE Hanson (eds), Cambridge University Press.

IPCC 2007b, *Summary for Policymakers. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*,.

IPCC 2012, *Managing the risk of extreme events and disasters to advance climate change adaptation. A special report of Working Groups I and II of the Intergovernmental Panel*

on Climate Change, Cambridge University Press, Cambridge, UK, and New York, NY, USA.

IPCC 2014a, 'Annex II: Glossary', in KJ Mach, S Planton, & C von Stechow (eds), *Climate change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva, Switzerland, pp. 117–130.

IPCC 2014b, *Climate Change 2014: Impacts, adaptation, and vulnerability Part A: Global and sectoral aspects. Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* CB Field, VR Barros, DJ Dokken, KJ Mach, MD Mastrandrea, TE Bilir, M Chatterjee, KL Ebi, YO Estrada, RC Genova, B Girma, E. Kissel, AN Levy, S MacCracken, P. Mastrandrea, & L. White (eds), Cambridge University Press,.

IPCC 2014c, *Climate change 2014 synthesis report summary for policymakers*, Geneva, Switzerland , accessed April 30, 2019, from <https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf>.

IPCC 2018, *Global Warming of 1.5°C.An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*, accessed from <https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf>.

IPCC 2019a, *Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*,.

IPCC 2019b, *Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* PR Shukla, J Skea, EC Buendia, V Masson-Delmotte, H-O Pörtner, DC Roberts, P Zhai, R Slade, S Connors, R van Diemen, M Ferrat, E Haughey, SN S. Luz, M Pathak, J Petzold, JP Pereira, P Vyas, E Huntley, K Kissick, M Belkacemi, & J Malley (eds), In Press.

IPCC 2022, *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* H. Pörtner, D. Roberts, M Tignor, E. Poloczanska, K Mintenbeck, A Alegría, M Craig, S Langsdorf, S Löschke, V Möller, A Okem, & B Rama (eds), Cambridge University Press, accessed from <https://www.ipcc.ch/report/ar6/wg2/downloads/report/%0AIPCC_AR6_WGII_FinalDraft_FullReport.pdf>.

Jabareen, Y 2012, 'Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk', *Cities*, vol. 21, pp. 220–229.

Jakku, E, Thorburn, PJ, Marshall, NA, Dowd, AM, Howden, SM, Mendham, E, Moon, K & Brandon, C 2016, 'Learning the hard way: A case study of an attempt at agricultural transformation in response to climate change', *Climatic Change*, vol. 137, no. 3–4, pp. 557–574.

James, R, Otto, F, Parker, H, Boyd, E, Cornforth, R, Mitchell, D & Allen, M 2014, 'Characterising loss and damage from climate change', *Nature*, vol. 4, pp. 938–939.

Janif, SZ, Nunn, PD, Geraghty, P, Aalbersberg, W, Thomas, FR & Camailakeba, M 2016, 'Value of traditional oral narratives in building climate-change resilience: Insights from

rural communities', *Ecology and Society*, vol. 21, no. 2.

Jeggle, T & Boggero, M 2018, *Post-disaster needs assessment PDNA. Lessons form a decade of experience.*, accessed June 5, 2019, from <www.worldbank.org>.

Kafle, SK 2011, 'Measuring disaster-resilient communities: A case study of coastal communities in Indonesia', *Journal of Business Continuity & Emergency Planning*, vol. 5, no. 4, pp. 315–325.

Kakota, T, Nyariki, D, Mkwambisi, D & Kogi-Makau, W 2011, 'Gender vulnerability to climate variability and household food insecurity Gender vulnerability to climate variability and household food insecurity', *Climate and Development* , vol. 3, no. 4, pp. 298–309.

Karan, Y 2020, 'Ministry of Sugar Industry: Capital Grant 2019/2020', accessed November 25, 2020, from <http://www.pmoffice.gov.fj/ministry-of-sugar-industry-capital-grants-2019-2020/>.

Kates, RW, Travis, WR & Wilbanks, TJ 2012, 'Transformational adaptation when incremental adaptations to climate change are insufficient', *Proceedings of the National Academy of Sciences of the United States of America*, vol. 109, no. 19, pp. 7156–7161.

Kelman, I 2014, 'No change from climate change: Vulnerability and small island developing states', *Geographical Journal*, vol. 180, no. 2, pp. 120–129.

Kelman, I 2018a, 'Lost for Words Amongst Disaster Risk Science Vocabulary?', *International Journal of Disaster Risk Science*, vol. 9, no. 3, pp. 281–291.

Kelman, I 2018b, 'Islandness within climate change narratives of small island developing states (SIDS)', *Island Studies Journal*, vol. 13, no. 1, pp. 149–166.

Kelman, I 2019, 'Pacific island regional preparedness for El Niño', *Environment, Development and Sustainability*, vol. 21, pp. 405–428.

Kenny, M & Fourie, R 2015, 'Contrasting classic, Straussian, and constructivist grounded theory: Methodological and philosophical conflicts', *The Qualitative Report* , vol. 20, no. 8, pp. 1270–1289.

Kissinger, G, Gupta, A, Mulder, I & Unterstell, N 2019, 'Climate financing needs in the land sector under the Paris Agreement: An assessment of developing country perspectives', *Land Use Policy*, vol. 83, pp. 256–269.

Klein, RJT, Midgley, GF, Preston, BL, Alam, M, Berkhout, FGH, Dow, K & Shaw, MR 2015, 'Adaptation opportunities, constraints, and limits', in C. Field, VR Barros, DJ Dokken, K. Mach, MD Mastrandrea, TE Bilir, M Chatterjee, E. Ebi, YO Estrada, RC Genova, B Girma, ES Kissel, AN Levy, S MacCracken, P. Mastrandrea, & LL White (eds), *Climate Change 2014 Impacts, Adaptation and Vulnerability: Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, United Kingdom and New York, NY, USA, pp. 899–944.

Klöck, C & Nunn, PD 2019, 'Adaptation to climate change in Small Island Developing States: A systematic literature review of academic research', *Journal of Environment and Development*, vol. 28, no. 2, pp. 196–218.

Kofinas, GP & Chapin, FS 2009, 'Sustaining livelihoods and human well-being during social – ecological change', in *Principles ofEcosystem Stewardship*, SpringerScience, pp. 55–75.

Koroiwaqa, I 2016, *Climate change impacts in Ra and Kadavu Provinces, Fiji*, Suva, Fiji.

Kreienkamp, J & Vanhala, L 2017, *Climate change loss and damage. Policy brief,* University College London.

Kuleshov, Y, McGree, S, Jones, D, Charles, A, Cottrill, A, Prakash, B, Atalifo, T, Nihmei, S & Seuseu, FLSK 2014, 'Extreme weather and climate events and their impacts on island countries in the Western Pacific: Cyclones, floods and droughts', *Atmospheric and Climate Sciences*, vol. 4, pp. 803–818.

Kumar, R, Stephens, M & Weir, T 2013, 'Rainfall trends in Fiji', *International Journal of Climatology*, vol. 34, no. 5, pp. 1501–1510.

Kumar, S & Bhati, JP 2011, 'Challenges and opportunities for agrarian transformation and development of agribusinesses in Fiji', *Asia-Pacific Journal of Rural Development*, vol. 21, no. 2, pp. 19–38.

Kumar, V, Deo, RC & Ramachandran, V 2006, 'Total rain accumulation and rain-rate analysis for small tropical Pacific islands: A case study of Suva, Fiji', *Atmospheric Science Letters*, vol. 248, no. 7, pp. 53–58.

Kumari, R & Nakano, Y 2016, 'Does land lease tenure insecurity cause decreased productivity and investment in the sugar industry? Evidence from Fiji', *Australian Journal of Agricultural and Resource Economics*, vol. 60, no. 3, pp. 406–421.

Künzel, V, Schäfer, L, Minninger, S & Baldrich, R 2017, *Loss and Damage at COP23: Looking at Small Island Developing States*, Germanwatch.

Kurer, O 2001a, 'Land tenure and sugar production in Fiji: Property rights and economic performance', *Pacific Economic Bulletin*, vol. 16, no. 2, pp. 94–105.

Kurer, O 2001b, 'Land and politics in Fiji: Of failed land reforms and coups', *Journal of Pacific History*, vol. 36, no. 3, pp. 299–315.

Kuruppu, N & Willie, R 2015, 'Barriers to reducing climate enhanced disaster risks in Least Developed Country-Small Islands through anticipatory adaptation', *Weather and Climate Extremes*, vol. 7, pp. 72–83.

Kvale, S 2006, 'Qualitative inquiry dominance through interviews and dialogues', *Qualitative Inquiry*, vol. 12, pp. 480–500.

Lal, B & Prete, M 2008, *Coup. Reflections on the political crisis in Fiji* B Lal & M Prete (eds), The Australian National University, accessed July 11, 2019, from <https://press-files.anu.edu.au/downloads/press/p97751/pdf/book.pdf>.

Lal, M 2004, 'Implications of climate change in Small Island Developing Countries of the South Pacific', *Fijian Studies*, vol. 2, no. 1, pp. 15–35.

Lal, P 2000, 'Land, Lomé and the Fiji sugar industry', in *Fiji Before the Storm*, pp. 111–133.

Lal, P, Lim-Applegate, H & Reddy, M 2001, 'The land tenure dilemma in Fiji- Can Fijian landowners and Indo-Fijian tenants have their cake and eat it too?', *Pacific Economic Bulletin*, vol. 16, no. 2, pp. 106–119.

Lal, PN, Rita, R & Khatri, N 2009, *Economic Costs of the 2009 Floods in the Fiji Sugar Belt and Policy Implications*, Gland, Switzerland.

Lamhauge, N, Lanzi, E & Agrawala, S 2013, 'The use of indicators for monitoring and evaluation of adaptation: lessons from development cooperation agencies', *Climate and Development*, vol. 5, no. 3, pp. 229–241.

Lata, S & Nunn, P 2012, 'Misperception of climate change risks as barriers to climate change adaptation: A case study from Rewa Delta, Fiji', *Climatic Change*, vol. 110, no. 1–2, pp. 169–186.

Lauerburg, RAM, Diekmann, R, Blanz, B, Gee, K, Held, H, Kannen, A, Möllmann, C, Probst, WN, Rambo, H, Cormier, R & Stelzenmüller, V 2020, 'Socio-ecological vulnerability to tipping points: A review of empirical approaches and their use for marine management', *Science of the Total Environment*, vol. 705.

Lejars, C, Auzoux, S, Siegmund, B & Letourmy, P 2010, 'Implementing sugarcane quality-based payment systems using a decision support system', *Computers and Electronics in Agriculture*, vol. 70, no. 1, pp. 225–233.

Li, Y, Ye, W, Wang, M & Yan, X 2009, 'Climate change and drought: a risk assessment of crop-yield impacts', *Climate Research*, vol. 39, no. June, pp. 31–46.

Lightfoot, C 1999, *Regional El Nino social and economic drought impact assessment and mitigation study*, accessed August 20, 2019, from <http://sopaccompendium.spc.int/data/Reports/TR0303.pdf>.

Linnerooth-Bayer, J & Mechler, R 2007, 'Disaster safety nets for developing countries: Extending public-private partnerships', *Environmental Hazards*, vol. 7, no. 1, pp. 54–61.

Long, S, Roberts, E & Dehm, J 2010, 'Climate justice inside and outside the UNFCCC: The example of REDD', *Journal of Australian Political Economy*, vol. 66, pp. 222–246.

Longhurst, R 2010, 'Semi-structured interviews and focus groups', in N Clifford, S French, & G Valentine (eds), *Key Methods in Geography*, pp. 103–115, accessed July 2, 2019, from <https://is.muni.cz/el/1431/jaro2015/Z0132/um/54979481/_Nicholas_Clifford__Gill_Valentine__Key_Methods_in_BookFi.org_.pdf#page=126>.

Mace, MJ & Verheyen, R 2016, 'Loss, damage and responsibility after COP21: All options open for the Paris agreement', *Review of European, Comparative and International Environmental Law*, vol. 25, no. 2, pp. 197–214.

Mackieson, P, Shlonsky, A & Connolly, M 2019, 'Increasing rigor and reducing bias in qualitative research: A document analysis of parliamentary debates using applied thematic analysis', *Qualitative Social Work*, vol. 18, no. 6, pp. 965–980.

Magee, AD, Verdon-Kidd, DC, Kiem, AS & Royle, SA 2016, 'Tropical cyclone perceptions, impacts and adaptation in the Southwest Pacific: An urban perspective from Fiji, Vanuatu and Tonga', *Natural Hazards and Earth System Sciences*, vol. 16, no. 5, pp. 1091–1105.

Mahadevan, R 2007, 'Fiji's sugar woes: The challenge of the land tenure system, ethnicity and the erosion of EU sugar preferences', in *Australian Agricultural and Resource Economics Society's 51st Annual Conference,* Queenstown, New Zealand., pp. 1–23.

Mahadevan, R 2008, 'The high price of sweetness: The twin challenges of efficiency and soil erosion in Fiji's sugar industry', *Ecological Economics*, vol. 66, no. 2–3, pp. 468–477.

Mahadevan, R 2009, 'The less than sweet solution to Fiji's sugar industry problems', *Journal of International Development*, vol. 21, no. 10–13, pp. 126–136.

Maldonado, AD, Morales, M, Aguilera, PA & Salmerón, A 2020, 'Analyzing uncertainty in complex socio-ecological networks', *Entropy*, vol. 22, no. 1, p. 123.

Malsale, P, Sanau, N, Tofaeono, TI, Kavisi, Z, Willy, A, Mitiepo, R, Lui, S, Chambers, LE & Plotz, RD 2018, 'Protocols and partnerships for engaging Pacific Island Communities in

the collection and use of traditional climate knowledge', *Bulletin of the American Meteorological Society*, vol. 99, no. 12, pp. 2471–2489.

Mansur, A, Doyle, J & Ivaschenko, O 2017, *Social protection and humanitarian assistance nexus for disaster response: Lessons learnt from Fiji's tropical cyclone Winston*, Fiji.

Manuel-Navarrete, D & Pelling, M 2015, 'Subjectivity and the politics of transformation in response to development and environmental change', *Global Environmental Change*, vol. 35, pp. 558–569.

De Marez, L, Bee, S, Bartle, B, Chintulga, O & Nguyen, C 2022, *Accessing climate finance: Challenges and opportunites for Small Island Developing States*, The United Nations.

Martin, PCM, Nunn, P, Leon, J & Tindale, N 2018, 'Responding to multiple climate-linked stressors in a remote island context: The example of Yadua Island, Fiji', *Climate Risk Management*, vol. 21, pp. 7–15.

Mataki, M, Koshy, KC & Lal, M 2006, 'Baseline climatology of Viti Levu (Fiji) and current climatic trends', *Pacific Science*, vol. 60, no. 1, pp. 49–68.

Matyas, D & Pelling, M 2015, 'Positioning resilience for 2015: The role of resistance, incremental adjustment and transformation in disaster risk management policy', *Disasters*, vol. 39, no. s1, pp. 1–18.

McCubbin, S, Smit, B & Pearce, T 2015, 'Where does climate fit? Vulnerability to climate change in the context of multiple stressors in Funafuti, Tuvalu', *Global Environmental Change*, vol. 30, pp. 43–55.

Mcleod, E, Bruton-adams, M, Förster, J, Franco, C, Gaines, G, Gorong, B, James, R, Posing-kulwaum, G, Tara, M, Terk, E & Lorenzo, E Di 2019, 'Lessons from the Pacific Islands – Adapting to climate change by supporting social and ecological resilience', *Frontiers in Marine Science*, vol. 6, no. June, pp. 1–7.

McNamara, KE 2014, 'Exploring loss and damage at the international climate change talks', *International Journal of Disaster Risk Science*, vol. 5, pp. 242–246, accessed April 26, 2019, from <www.springer.com/13753>.

McNamara, KE, Bronen, R, Fernando, N & Klepp, S 2018, 'The complex decision-making of climate-induced relocation: Adaptation and loss and damage', *Climate Policy*, vol. 18, no. 1, pp. 111–117.

McNamara, KE & Buggy, L 2017, 'Community-based climate change adaptation: A review of academic literature', *Local Environment*, vol. 22, no. 4, pp. 443–460.

McNamara, KE, Clissold, R & Westoby, R 2020, 'Women's capabilities in disaster recovery and resilience must be acknowledged, utilized and supported', *Journal of Gender Studies*, vol. 00, no. 00, pp. 1–7.

McNamara, KE & Gibson, C 2009, '"We do not want to leave our land": Pacific ambassadors at the United Nations resist the category of "climate refugees"', *Geoforum*, vol. 40, pp. 475–483.

McNamara, KE & Jackson, G 2019, 'Loss and damage: A review of the literature and directions for future research', *Wiley Interdisciplinary Reviews: Climate Change*, vol. 10, no. 2, pp. 1–16.

McNamara, KE & Jacot Des Combes, H 2015, 'Planning for community relocations due to climate change in Fiji', *International Journal of Disaster Risk Science*, vol. 6, pp. 315–319.

McNamara, KE & Prasad, SS 2014, 'Coping with extreme weather: Communities in Fiji and Vanuatu share their experiences and knowledge', *Climatic Change*, vol. 123, no. 2, pp. 121–132.

McNamara, KE & Westoby, R 2020, 'Marketplaces as sites for the development-adaptation-disaster trifecta : Insights from Vanuatu', Asia Pacifc Viewpoint.

McNamara, KE, Westoby, R & Chandra, A 2021, 'Exploring climate-driven non-economic loss and damage in the Pacific Islands', *Current Opinion in Environmental Sustainability*, vol. 50, pp. 1–11.

McNamara, KE, Westoby, R, Clissold, R & Chandra, A 2021, 'Understanding and responding to climate-driven non-economic loss and damage in the Pacific Islands', *Climate Risk Management*, vol. 33, pp. 1–14.

Mearns, R & Norton, A 2010, *Social dimensions of climate change. Equiy and vulnerability in a warming world* Robin Mearns & Andrew Norton (eds), The World Bank, accessed July 4, 2019, from <http://documents.worldbank.org/curated/en/970361468324546268/pdf/520970PUB0EPI11C010disclosed0Dec091.pdf#page=73>.

Mechler, R, Bouwer, LM, Linnerooth-Bayer, J, Hochrainer-Stigler, S, Aerts, JCJH, Surminski, S & Williges, K 2014, 'Managing unnatural disaster risk from climate extremes', *Nature Climate Change*, vol. 4, no. 4, pp. 235–237.

Mechler, R & Schinko, T 2016, 'Identifying the policy space for climate loss and damage', *Science*, vol. 354, no. 6310, pp. 290–292.

Mechler, R, Singh, C, Ebi, K, Djalante, R, Thomas, A, James, R, Tschakert, P, Wewerinke-Singh, M, Schinko, T, Ley, D, Nalau, J, Bouwer, LM, Huggel, C, Huq, S, Linnerooth-Bayer, J, Surminski, S, Pinho, P, Jones, R, Boyd, E & Revi, A 2020, 'Loss and Damage and limits to adaptation: recent IPCC insights and implications for climate science and policy', *Sustainability Science*, vol. 15, no. 4, pp. 1245–1251.

Mercer, J 2010, 'Disaster risk reduction or climate change adaptation: Are we reinventing the wheel?', *Journal of International Development*, vol. 22, pp. 247–264.

Mercer, J, Kelman, I & Dekens, J 2009, 'Integrating indigenous and scientific knowledge for disaster risk reduction', *Indigenous Knowledge and Disaster Risk Reduction: From Practice to Policy*, vol. 34, no. 1, pp. 115–131.

Mero- Jaffe, I 2011, 'Is that what I said?' Interview transcript approval by participants: An aspect of ethics in qualitative research, *International Journal of Qualitative Methods*, vol. 10, no.(3), pp. 231-247.

Mills, J, Bonner, A & Francis, K 2006a, 'Adopting a constructivist approach to grounded theory: Implications for research design', *International Journal of Nursing Practice*, vol. 12, no. 1, pp. 8–13.

Mills, J, Bonner, A & Francis, K 2006b, 'The development of constructivist grounded theory', *International Journal of Qualitative Methods*, vol. 5, no. 1, pp. 25–35.

Mills, J, Harrison, H, Franklin, R & Birks, M 2017, 'Case study research: Foundations and methodological orientations', *Forum Qualitative Sozialforschung*, vol. 18, no. 1, pp. 1–17.

Ministry of Communication 2021, 'Ministry of Sugar Industry Develops Manual for Implementation of Captial Programs', accessed May 5, 2021, from <https://www.fiji.gov.fj/Media-Centre/News/MINISTRY-OF-SUGAR-INDUSTRY-

DEVELOPS-MANUAL-FOR-IMP>.

Ministry of Economy 2016a, *Disaster recovery framework*, Suva, Fiji.

Ministry of Economy 2016b, *Republic of Fiji. Economic anf fiscal update: Supplement to the 2016-2017 budget address*, Suva, Fiji.

Ministry of Economy 2018, *ECAL in Action*, Suva, Fiji.

Ministry of Economy 2019, *Republic of Fiji national climate change policy 2018 – 2030*, Suva.

Ministry of Economy 2020a, *Fiji Technology needs assessment report mitigation*, accessed from <https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2020/06/tna-adaptation-report-myanmar.pdf>.

Ministry of Economy 2020b, *Technology needs assessment report for adaptation*, accessed from <https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2020/06/tna-adaptation-report-myanmar.pdf>.

Ministry of Sugar Industry 2021a, 'Ministry of Sugar Industry- About us', accessed January 16, 2021, from <https://www.sugar.gov.fj/about-us/>.

Ministry of Sugar Industry 2021b, 'Legislation and Acts', accessed January 14, 2021, from <https://www.sugar.gov.fj/legislations-acts/>.

Miola, A, Paccagnan, V, Papadimitriou, E & Mandrici, A 2015, *Climate resilient development index: theoretical framework, selection criteria and fit-for-purpose indicators*, accessed from <https://ec.europa.eu/jrc>.

Miyaji, M, Fujieda, A, Veitata, S & Kobayashi, H 2021, 'Field research on cyclone damage and housing reconstruction in Fijian Village—Case study of Navala Village after tropical cyclone Winston', *Japan Architectural Review*, vol. 4, no. 3, pp. 504–514.

Mohajan, H 2018, 'Qualitative research methodology in social sciences and related subjects', *Journal of Economic Development, Environment and People*, vol. 7, pp. 23–48, accessed July 1, 2019, from <https://mpra.ub.uni-muenchen.de/85654/1/MPRA_paper_85654.pdf>.

Monnereau, I & Abraham, S 2013, 'Limits to autonomous adaptation in response to coastal erosion in Kosrae, Micronesia', *International Journal of Global Warming*, vol. 5, no. 4, pp. 416–432.

Moore, L 2022, 'Putting principles into practice: Lessons from Fiji on planned relocations', *Forced Migration Review*, no. 69, pp. 51–53.

Moore, M-L, Westley, F, Tjornbo, O & Holroyd, C 2015, 'The loop, the lens, and the lesson: Using resilience theory to examine public policy and social innovation', in *International Encyclopedia of the Social and Behavioral Sciences:*, pp. 355–361.

Morgan, DL 2014, 'Pragmatism as a paradigm for social research', *Qualitative Inquiry*, vol. 20, no. 8, pp. 1045–1053.

Morrisey, S & Reser, J 2003, 'Evaluating the effectiveness of advice in community cyclone psychological preparedness preparedness materials', *The Australian Journal of Emergency Management*, vol. 18, no. 2.

Morrison, K & Nand, M. M 2023, 'Ecological resilience for transformative climate change mitigation and adaptation' in *Handbook of Disaster Risk Reduction and Resilience: Climate Changes and Socio-Hydrological Sustainability*, Springer-Nature DOI

10.1007/978-3-031-22112-5

Morrison, K 2021, 'Community-based human ecological research for climate change adaptation: Taking faith and culture seriously', in *Handbook of Climate Change Management*.

Morrison, K, Nand, MM & Lal, H 2019, *Nurturing adaptive capacity through self-regulated learning for online postgraduate courses on climate change adaptation*, Springer International Publishing, accessed from <http://dx.doi.org/10.1007/978-3-030-32898-6_27>.

Morrissey, J & Oliver-Smith, A 2013, *Perspectives on non-economic loss and damage: Understanding values at risk from climate change*, Dhaka, Bangladesh, accessed from <https://www.researchgate.net/publication/289130103>.

Morse, JM 2015, 'Critical analysis of strategies for determining rigor in qualitative inquiry', *Qualitative Health Research*, vol. 25, no. 9, pp. 1212–1222.

Morse, JM 2016, 'Underlying ethnography', *Qualtative Health Research*, vol. 26, no. 7, pp. 875–876.

Morton, JF 2007, 'The impact of climate change on smallholder and subsistence agriculture', *Proceedings of the National Academy of Sciences of the United States of America*, vol. 104, no. 50, pp. 19680–19685.

Moser, Susanne C & Ekstrom, JA 2010, 'A framework to diagnose barrier to climate change adaptation', *PNAS*, vol. 107, no. 51, pp. 22026–22031.

Moser, S. C. & Ekstrom, JA 2010, 'A framework to diagnose barriers to climate change adaptation', *Proceedings of the National Academy of Sciences*, vol. 107, no. 51, pp. 22026–22031.

Moynagh 1978, 'Land tenure in Fiji's sugar cane districts since the 1920s', *The Journal of Pacific History*, vol. 13, no. 1, pp. 53–73.

Murken, L & Gornott, C 2022, 'The importance of different land tenure systems for farmers' response to climate change: A systematic review', *Climate Risk Management*, vol. 35, no. January, p. 100419.

Naivalu, S, Vaike, L, Jesse, M, Lees, J & Sam, Q 2022, *Beyond Barriers: Fiji Case Study*, Fiji.

Nakamura, N & Kanemasu, Y 2020, 'Traditional knowledge, social capital, and community response to a disaster: Resilience of remote communities in Fiji after a severe climatic event', *Regional Environmental Change*, vol. 20, no. 1.

Nakhooda, S, Watson, C & Schalatek, L 2013, *The global climate finance architecture*, accessed October 4, 2019, from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.634.7698&rep=rep1&type=pdf>.

Nand, M & Bardsley, DK 2020, 'Climate change loss and damage policy implications for Pacific Island Countries', *Local Environment*, vol. 25, no. 9, pp. 725–740.

Nand, MM, Iese, V, Singh, U, Wairiu, M, Jokhan, A & Prakash, R 2016, 'Evaluation of decision support system for agrotechnology transfer SUBSTOR potato model (v4.5) under tropical conditions', *The South Pacific Journal of Natural and Applied Sciences*, vol. 34, no. 1, p. 1.

Narayan, PK & Prasad, BC 2003, *Sugar industry reform in Fiji, production decline and its*

economic consequences, Victoria, Australia.

Nasokia, W 2018, 'Cane Farmers Receive Tree Samples', accessed November 25, 2020, from <https://fijisun.com.fj/2018/03/22/cane-farmers-receive-tree-samples/>.

Nawai, J, Gusyev, M, Hasegawa, A & Takeuchi, K 2015a, 'Flood and drought assessment with dam infrastructure: A case study of the Ba River basin, Fiji', in *21st International Congress on Modelling and Simulation*, Gold Coast, Australia, pp. 1607–1613.

Nawai, J, Gusyev, M, Hasegawa, A & Takeuchi, K 2015b, 'Flood and drought assessment with dam infrastructure: A case study of the Ba River basin, Fiji', in *21st International Congress on Modelling and Simulation*, Gold Coast, Australia, pp. 1607–1613.

Neef, A, Benge, L, Boruff, B, Pauli, N, Weber, E & Varea, R 2018, 'Climate adaptation strategies in Fiji: The role of social norms and cultural values', *World Development*, vol. 107, pp. 125–137.

Nhamo, G & Nhamo, S 2016, 'Paris (COP21) Agreement: Loss and damage, adaptation and climate finance issues', *International Journal of African Renaissance Studies*, vol. 11, no. 2, pp. 118–138.

Nichols, A 2019, 'Climate change, natural hazards, and relocation: Insights from Nabukadra and Navuniivi villages in Fiji', *Climatic Change*, vol. 156, pp. 255–271.

Njie, B & Asimiran, S 2014, 'Case study as a choice in qualitative methodology', *IOSR Journal of Research & Method in Education*, vol. 4, no. 3, pp. 35–40.

Noor, KBM 2008, 'Case study: A strategic research methodology', *American Journal of Applied Sciences*, vol. 5, no. 11, pp. 1602–1604.

Nordlander, L, Pill, M & Romera, BM 2020, 'Insurance schemes for loss and damage: fools' gold?', *Climate Policy*, vol. 20, no. 6, pp. 704–714.

Noy, I & Edmonds, C 2016, *The economic and fiscal burdens of disasters in the Pacific*, accessed August 7, 2019, from <www.victoria.ac.nz/sef>.

Nunn, P 2009, 'Responding to the challenges of climate change in the Pacific Islands: management and technological imperatives', *Climate Reserach*, vol. 40, pp. 211–231.

Nunn, PD, Aalbersberg, W, Lata, S & Gwilliam, M 2014, 'Beyond the core: Community governance for climate-change adaptation in peripheral parts of Pacific Island Countries', *Regional Environmental Change*, vol. 14, pp. 221–235.

Nurse, LA, McLean, RF, Agard Trinidad, J, Pascal Briguglio, L, Duvat-Magnan, V, Pelesikoti, N, Tompkins, E, Webb, A, Campbell, J, Chadee Trinidad, D, Maharaj Trinidad, S, Morin, V, Jan van Oldenborgh, G, Payet, R, Scott, D, Spencer, T, Yasuhara, K, Field, C, Dokken, D, Mach, K, Bilir, T, Chatterjee, M, Ebi, K, Estrada, Y, Genova, R, Girma, B, Kissel, E, Levy, A, MacCracken, S, Mastrandrea, P & White, L 2014, *Chapter 29: Small islands. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change*.

O'Brien, K 2012, 'Global environmental change II: From adaptation to deliberate transformation', *Progress in Human Geography*, vol. 36, no. 5, pp. 667–676.

O'brien, K, Eriksen, S, Schjolden, A & Nygaard, L 2004, *Conflicting interpretations of vulnerability in climate change research*, Oslo, Norway, accessed from <http://www.cicero.uio.no>.

OECD 2001, *Adoption of Technologies for sustainable farming systems*, Wageningen Workshop Proceedings, France.

Ohdedar, B 2016, 'Loss and damage from the impacts of climate change: A framework for implementation', *Nordic Journal of International Law*, vol. 85, no. 1, pp. 1–36.

Otto, P, Mehta, A & Liu, B 2018, 'Mind The Gap: Towards and Beyond Impact Messaging to Enhance Tropical Cyclone Risk Communication', *Tropical Cyclone Research and Review*, vol. 7, no. 2, pp. 140–151.

Oxfam 2016, *After Paris: Climate finance in the Pacific Islands. Strengthening collaboration, accelerating access and prioritising adaptation for vulnerable communities*, accessed April 30, 2019, from <www.oxfam.org.au/pacificclimatefinance>.

Pacific Community 2012, *Republic of Fiji – National climate change policy*, accessed July 11, 2019, from <https://www.sprep.org/attachments/Climate_Change/Fiji-National-Climate-Change-Policy.pdf>.

Pacific Food Security Cluster 2016, *Tropical cyclone Winston food security and livelihoods recovery needs assessment*, Suva, Fiji.

Pacific Islands Forum Secretariat 2022, 'Communique of the 51st Pacific Islands Forum Leaders Meeting', accessed July 31, 2022, from <https://www.forumsec.org/2022/07/17/report-communique-of-the-51st-pacific-islands-forum-leaders-meeting/>.

Packer, MJ & Goicoechea, J 2010, 'Sociocultural and constructivist theories of learning: Ontology, not just epistemology', *Educational Psychologist*, vol. 35, no. 4, pp. 227–241.

Page, EA & Heyward, C 2017, 'Compensating for climate change loss and damage', *Political Studies*, vol. 65, no. 2, pp. 356–372.

Pahl-wostl, C 2012, 'Continuity and Change in Social-ecological Systems : the Role of', *Ecological and society*, vol. 17, no. 2, accessed from <file:///Users/DURU/Documents/Mendeley Desktop/Pahl-wostl - 2012 - Continuity and Change in Social-ecological Systems the Role of.pdf>.

Pandey, R & Bardsley, DK 2015, 'Social-ecological vulnerability to climate change in the Nepali Himalaya', *Applied Geography*, vol. 64, pp. 74–86.

Park, SE, Marshall, NA, Jakku, E, Dowd, AM, Howden, SM, Mendham, E & Fleming, A 2012, 'Informing adaptation responses to climate change through theories of transformation', *Global Environmental Change*, vol. 22, no. 1, pp. 115–126

Park, YS, Konge, L & Artino, AR 2020, 'The positivism paradigm of research', *Academic Medicine*, vol. 95, no. 5, pp. 690–694.

Pauw, WP, Klein, RJT, Mbeva, K, Dzebo, A, Cassanmagnago, D & Rudloff, A 2018, 'Beyond headline mitigation numbers: We need more transparent and comparable NDCs to achieve the Paris Agreement on climate change', *Climatic*, vol. 147, pp. 23–29.

PCRAFI 2011, *Country risk profile: Fiji*, accessed June 13, 2019, from <http://documents.worldbank.org/curated/en/824681468000924094/pdf/96742-BRI-Box391446B-PUBLIC-Fiji.pdf>.

Pearce, T, Currenti, R, Mateiwai, A & Doran, B 2018, 'Adaptation to climate change and freshwater resources in Vusama village, Viti Levu, Fiji', *Regional Environmental Change*, vol. 18, no. 2, pp. 501–510.

Pearce, T, Renee C, Brendan D, Roy S, James F & Javier L 2020 'Even if it doesn't come, you should be prepared': Natural hazard perception, remoteness, and implications for disaster risk reduction in rural Fiji', *International Journal of Disaster Risk Reduction*,

vol. 48, no. 101591, pp. 1-7. doi:10.1016/j.ijdrr.2020.101591.

Pekkarinen, V, Toussaint, P & van Asselt, H 2019, 'Loss and Damage after Paris: Moving beyond rhetoric', *Carbon & Climate Law Review*, vol. 13, no. 1, pp. 31–49.

Pelling, M 2011a, *Adaptation to climate chnage. From resilience to transfromation*, Routledge, New York.

Pelling, M 2011b, *Adaptation to Climate Change: From resilience to transformation*, accessed July 8, 2019, from <www.eBookstore.tandf.co.uk.>.

Pelling, M & Manuel-Navarrete, D 2011, 'From resilience to transformation: the adaptive cycle in two Mexican urban centers', *Ecology and Society*, vol. 16, no. 2, p. 11.

Pelling, M, O'Brien, K & Matyas, D 2015, 'Adaptation and transformation', *Climatic Change*, vol. 133, no. 1, pp. 113–127.

Pelling, M & Uitto, JI 2001, 'Small island developing states: Natural disaster vulnerability and global change', *Environmental Hazards*, vol. 3, no. 2, pp. 49–62.

Pierre-Nathoniel, D, Siegele, L, Roper, L-A & Menke, I 2019, 'Loss and Damage at COP25 – a hard fought step in the right direction', *The Climate Analytics Blog*, accessed January 20, 2020, from <https://climateanalytics.org/blog/2019/loss-and-damage-at-cop25-a-hard-fought-step-in-the-right-direction/>.

Piggott-McKellar, A, McNamara, K, Nunn, P & Sekinini, S 2019, 'Moving people in a changing climate: Lessons from two case studies in Fiji', *Social Sciences*, vol. 8, no. 5, p. 133.

Pill, M 2021, 'Re-framing non-economic losses to non-economic impacts for effective policymaking: Evidence from the Caribbean', *Climate and Development*, pp. 1–10.

Pill, M 2022, 'Towards a funding mechanism for loss and damage from climate change impacts', *Climate Risk Management*, vol. 35, no. March 2021, p. 100391.

Pinninti, KR 2013, 'Approaches for Assessing Loss and Damage', in pp. 11–24.

Ploger, S & Barakos, E 2021, 'Researching linguistic transitions of newly-arrived students in Germany: Insights from institutional ethnography and reflexive grounded theory', *Ethnography and Education*, pp. 1–19.

Porter, L, Rickards, L, Verlie, B, Moloney, S, Lay, B, Latham, B, Anguelovski, I, Pellow, D, Porter, L, Bosomworth, K, Rickards, L, Verlie, B, Moloney, S, Lay, B, Latham, B, BCNUEJ, IA, Pellow, DN, Naarm/Birrarung-ga, Porter, L, Bosomworth, K, Moloney, S, Verlie, B & Lay, B 2020, 'Climate Justice in a Climate Changed World', *Planning Theory and Practice*, vol. 21, no. 2, pp. 293–321.

Prasad, B & Kumar, S 2016, 'Institutional rigidities and economic performance in Fiji', in *Confronting Fiji Futures*, The Australian National University, Canberra, Australia, pp. 111–132.

Prasad, BC & Tisdell, C 2006, *Institutions, economic performance and sustainable development : A case study of the Fiji Islands*, New York.

Prasad, N 2019, 'Labour shortage. A factor in the decline of sugar production', *Fiji Sun*, accessed March 24, 2022, from <https://fijisun.com.fj/2019/02/12/labour-shortage-a-factor-to-the-decline-of-fiji-sugar-production/>.

Preston, BL, Dow, K & Berkhout, F 2013, 'The climate adaptation frontier', *Sustainability (Switzerland)*, vol. 5, no. 3, pp. 1011–1035.

Preston, CJ 2017, 'Challenges and opportunities for understanding non-economic loss and damage', *Ethics, Policy and Environment*, vol. 20, no. 2, pp. 143–155.

Preston, I, Banks, N, Hargreaves, K, Kazmierczak, A, Lucas, K, Mayne, R, Downing, C & Street, R 2014, *Climate change and social justice: An evidence review*, Joseph Rowntree Foundation Report.

Rabionet, SE 2011, 'How I learned to design and conduct semi-structured interviews: An ongoing and continuous journey', *The Qualitative Report*, vol. 16, no. 2, pp. 563–566.

Ralph, N, Birks, M & Chapman, Y 2015, 'The methodological dynamism of grounded theory', *International Journal of Qualitative Methods*, pp. 1–6, accessed July 8, 2019, from <https://us.sagepub.com/en-us/nam/open-access-at-sage>.

Ram, AR, Brook, MS & Cronin, SJ 2018, 'Geomorphological characteristics of slope failures in northeast Viti Levu island, Fiji, triggered by Tropical Cyclone Winston in February 2016', *New Zealand Geographer*, vol. 74, no. 2, pp. 64–76.

Raymond, CM & Robinson, GM 2013, 'Factors affecting rural landholders' adaptation to climate change: Insights from formal institutions and communities of practice', *Global Environmental Change*, vol. 23, no. 1, pp. 103–114.

Reddy, M 2003, 'Farm productivity, efficiency and profitability in Fiji's sugar industry', *Fijian Studies - A Journal of Contemporary Fiji*, vol. 1, no. 2, pp. 225–241.

Reddy, M & Lal, P 2002, 'State land transfer in Fiji: Issues and implications', *Pacific Economic Bulletin*, vol. 17, no. 1, pp. 146–153.

Reddy, M & Yanagida, JF 1998, 'Fiji's sugar industry at the crossroads', *Pacific Economic Bulletin*, vol. 13, no. 1, pp. 72–87.

Reddy, N 2003, 'Survival strategies for the Fiji sugar industry', *Fijian Studies*, vol. 1, no. 2, pp. 265–285.

Remling, E & Veitayaki, J 2016, 'Community-based action in Fiji's Gau Island: A model for the Pacific?', *International Journal of Climate Change Strategies and Management*, vol. 8, no. 3, pp. 375–398.

Republic of Fiji 2017, *Republic of Fiji talanoa dialogue submission "Where are we?"*, Suva, Fiji.

Rhee, J & Yang, H 2018, 'Drought prediction for areas with sparse monitoring networks: A case study for Fiji', *Water*, vol. 10, no. 6, pp. 1–19.

Richards, J-A & Schalatek, L 2017, *Financing loss and damage: A look at governance and implementation options*, Washington, DC, accessed from <http://us.boell.org/>.

Richards, J 2018, *Climate and gender justice. What's needed to finance loss and damage?*, accessed from <https://www.rosalux.de/en/publication/id/39802/climate-and-gender-justice>.

Rickards, L & Howden, SM 2012, 'Transformational adaptation: Agriculture and climate change', *Crop and Pasture Science*, vol. 63, no. 3, pp. 240–250.

Riddell, R 1990, *Judging success: Evaluating NGO approaches to alleviating poverty in developing countries*, Overseas Development Institute.

Ritchie, J, Lewis, J & Elam, G 2003, 'Designing and selecting samples', in *Qualitative research practice. A guide for social science students and researchers*, pp. 77–108.

Roberts, E, van der Geest, K, Warner, K & Anderi, S 2014, 'Loss and damage: When adaptation is not enough', *Environmental Development*, vol. 11, pp. 219–227.

Roberts, E & Pelling, M 2018, 'Climate change-related loss and damage: translating the global policy agenda for national policy processes', *Climate and Development*, vol. 10, no. 1, pp. 4–17.

Roberts, E & Pelling, M 2019, 'Loss and damage: an opportunity for transformation?', *Climate Policy*, pp. 1–14.

Roberts, JT, Natson, S, Hoffmeister, V, Durand, A, Weikmans, R, Gewirtzman, J & Huq, S 2017, 'How Will We Pay for Loss and Damage?', *Ethics, Policy and Environment*, vol. 20, no. 2, pp. 208–226.

Roberts, JT & Weikmans, R 2017, 'Postface: fragmentation, failing trust and enduring tensions over what counts as climate finance', *International Environmental Agreements: Politics, Law and Economics*, vol. 17, no. 1, pp. 129–137.

Robinson, O 2014, 'Sampling in interview-based qualitative research: A theoretical and practical guide', *Qualitative Research in Psychology*, vol. 11, no. 1, pp. 25–41.

Rockström, J, Steffen, W, Noone, K, Persson, Å, Chapin III, FS, Lambin, EF, Lenton, TM, Scheffer, M, Folke, C, Schellnhuber, HJ, Nykvist, B, de Wit, CA, Hughes, T, van der Leeuw, S, Rodhe, H, Sorlin, S, Snyder, PK, Costanza, R, Svedin, U, Falkenmark, M, Karlberg, L, Corell, RW, Fabry, VJ, Hansen, J, Walker, B, Liverman, D, Richardson, K, Crutzen, P & Foley, JA 2009, 'A safe operating space for humanity', *Nature*, vol. 461, pp. 472–475.

Rosen, AM 2015, 'The wrong solution at the right time: The failure of the kyoto protocol on climate change', *Politics and Policy*, vol. 43, no. 1, pp. 30–58.

Rosen, AM & Rivera-Collazo, I 2012, 'Climate change, adaptive cycles, and the persistence of foraging economies during the late Pleistocene/Holocene transition in the Levant', *Proceedings of the National Academy of Sciences*, vol. 109, no. 10, pp. 3640–3645.

Rowan Gard, A & Veitayaki, J 2017, 'In the wake of Winston – climate change, mobility and resiliency in Fiji', *International Journal of Safety and Security Engineering*, vol. 7, no. 2, pp. 157–168.

Rowe, WE 2014, 'Positionality.' The Sage Encyclopedia of Action Research, Sage.

Rowlands, IH 2001, 'The Kyoto Protocol's Clean Development Mechanism: A sustainability assessment', *Third World Quarterly*, vol. 22, no. 5, pp. 795–811.

Roy, A & Basu, S 2020, 'Determinants of livelihood diversification under environmental change in coastal community of Bangladesh', *Asia-Pacific Journal of Rural Development*, vol. 30, no. 1–2, pp. 7–26.

Ryan, G 2018, 'Introduction to positivism, interpretivism and critical theory', *Nurse Researcher*, vol. 25, no. 4, pp. 1–20.

Sachan, HK & Krishna, D 2021, 'Fiji Sugarcane Industry Amidst COVID-19 Pandemic', *Sugar Tech*, vol. 23, no. 3, pp. 473–475>.

Sami, J 2020, 'Time series dynamics of sugar export earnings in Fiji with multiple endogenous structural breaks: Implications for EU sugar and industry reforms', *Journal of Quantitative Economics*, vol. 18, no. 1, pp. 169–189.

Samuwai, J & Hills, JM 2018, 'Assessing climate finance readiness in the Asia-Pacific region', *Sustainability (Switzerland)*, vol. 10, no. 4, pp. 1–18.

Samuwai, J, Hills, JM & Michalena, E 2019, 'Thinking outside the box: Deepening private sector investments in Fiji's nationally determined contributions through scenario analysis', *Sustainability (Switzerland)*, vol. 11, no. 15, pp. 2–15.

Samuwai, S & Hills, J 2019, 'Gazing over the horizon. Will an equitable Green Climate Fund allocation policy be significant for the Pacific post-2020?', *Pacific Journalism Review*, vol. 25, no. 1 & 2, pp. 158–172.

Sattler, DN, Whippy, A, Graham, JM & Johnson, J 2018, 'A psychological model of climate change adaptation: Influence of resource loss, posttraumatic growth, norms, and risk perception following Cyclone Winston in Fiji', in WL Filho (ed), *Climate Change Impacts and Adaptation Strategies for Coastal Communities*, Springer International Publishing AG, pp. 427–443.

SCGC 2021, 'Sugarcane Growers Council', accessed May 4, 2021, from <https://scgf.com.fj/about-us/>.

Schaeffer, M, Baarsch, F, Balo, G, Bruin, K de, Calland, R, Fallasch, F, Melkie, ME, Verwey, L, Freitas, S, Marez, L De, Rooij, J van & Hare, B 2015, *Africa's Adaptation Gap 2 : Bridging the gap – mobilising sources*,.

Schäfer, L, Künzel, V & Fuhrmann, H 2019, *Steps towards closing the Loss & Damage finance gap*, GermanWatch.

Schalatek, L & Roberts, E 2021, 'Deferred not defeated: The outcome on Loss and Damage finance at COP26 and next steps', accessed September 15, 2022, from <https://us.boell.org/en/2021/12/16/deferred-not-defeated-outcome-loss-and-damage-finance-cop26-and-next-steps>.

Scheffran, J, Brzoska, M, Brauch, HG, Link, PM & Schilling, J 2012, *Climate change, human security and violent conflict: Challenges for societal stability* H Günter Brauch (ed), Springer, accessed August 23, 2019, from <https://link-springer-com.proxy.library.adelaide.edu.au/content/pdf/10.1007%2F978-3-642-28626-1.pdf>.

Schinko, T & Mechler, R 2017, 'Applying recent insights from climate risk management to operationalise the loss and damage mechanism', *Ecological Economics*, vol. 136, pp. 296–298.

Schinko, T, Mechler, R & Hochrainer-Stigler, S 2017, 'A methodological framework to operationalise climate risk management: managing sovereign climate-related extreme event risk in Austria', *Mitigation and Adaptation Strategies for Global Change*, vol. 22, pp. 1063–1086.

Schinko, T, Mechler, R & Hochrainer-Stigler, S 2019, 'The risk and policy space for loss and damage: integrating notions of distributive and compensatory justice with comprehensive climate risk management', in *Loss and damage from climate change. Concepts, methods and policy options*, Springer, pp. 83–110.

Schlosberg, D & Collins, LB 2014, 'From environmental to climate justice: Climate change and the discourse of environmental justice', *Wiley Interdisciplinary Reviews: Climate Change*, vol. 5, no. 3, pp. 359–374.

Scotland, J 2012, 'Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms', *English Language Teaching*, vol. 5, no. 9, pp. 9–16.

Serdeczny, O, Waters, E & Chan, S 2016, *Non-Economic loss and damage in the context of climate change understanding the challenges*, accessed from <www.die-gdi.de>.

Serrano, K 2007, 'Sweet like sugar: Does the EU's new sugar regime become Fiji's bitter reality or welcomed opportunity', *Journal of South Pacific Law*, vol. 11, no. 2, pp. 169–193.

Shabina, S, Antoine, B, Yeurt, DRN & Iese, V 2021, 'Integrated flood vulnerability assessment of villages in the Waimanu River Catchment in the South Pacific: The case of Viti Levu, Fiji', *Regional Environmental Change*, vol. 21, no. 83, accessed from <https://doi.org/10.1007/s10113-021-01824-9>.

Shakya, C, Cooke, K, Gupta, N, Bull, Z & Greene, S 2018, *Building institutional capacity for enhancing resilience to climate change: An operational framework and insights from practice*, accessed from <https://reliefweb.int/sites/reliefweb.int/files/resources/GIP01916-OPM-Strengthening-institutions-Proof4-web.pdf>.

Sharma-Khushal, S, Schalatek, L, Singh, H & White, H 2022, *The loss and damage finance facility. Why and how.*, Bonn, Germany.

Sharma, A 2017, 'Precaution and post-caution in the Paris Agreement: adaptation, loss and damage and finance', *Climate Policy*, vol. 17, no. 1, pp. 33–47.

Singh-Peterson, L & Iranacolaivalu, M 2018, 'Barriers to market for subsistence farmers in Fiji – A gendered perspective', *Journal of Rural Studies*, vol. 60, no. March, pp. 11–20.

Singh, A 2020, 'Benefits of crop diversification in Fiji's sugarcane farming', *Asia and the Pacific Policy Studies*, vol. 7, no. 1, pp. 65–80.

Singh, H 2018, *Expert Dialogue underscores finance gap to address climate induced 'Loss and Damage'*, accessed June 13, 2019, from <https://twnetwork.org/sites/default/files/TWN_update12_4.pdf>.

Smit, B & Wandel, J 2006, 'Adaptation, adaptive capacity and vulnerability', *Global Environmental Change*, vol. 16, no. 3, pp. 282–292.

Smith, J & Amjadali, A 2012, *Pacific Islands Climate Prediciton Project*, accessed from <http://pacificislandsclimate.org/storybook/Pacific_Islands_Climate_Storybook.pdf>.

Snell, D & Prasad, S 2001, '"Benchmarking" and participatory development: The case of Fiji's sugar industry reforms', *Development and Change*, vol. 32, no. 2, pp. 255–276.

SPC 2018, 'REFOREST: Reforestation of the Degraded Foothills of the Sugar Belt', accessed November 25, 2020, from <https://www.spc.int/special-projects/sugar-projects/sugar-projects-fiji/reforest-project>.

Spencer, MS, Fentress, T, Touch, A & Hernandez, J 2020, 'Environmental justice, indigenous knowledge systems, and native hawaiians and other pacific islanders', *Human Biology*, vol. 92, no. 1, pp. 45–57.

Spencer, R, Pryce, JM & Walsh, J 2014, 'Philosophical approaches to qualitative research', in *The Oxford Handbook of Qualitative Research*, pp. 81–98.

SRIF 2014, *Sugar research institute of Fiji strategic plan 2014-2020*, Fiji.

SRIF 2021a, 'Sugar Research Institute of Fiji', accessed May 4, 2021, from <https://srif.net.fj/about-us/>.

SRIF 2021b, 'Top 10 commercial varieties bred in Fiji in the past century', accessed February 15, 2022, from <https://www.srif.net.fj/page15.html>.

SRIF 2021c, 'Technology transfer', accessed February 15, 2022, from

<https://www.srif.net.fj/page12.html>.

SRIF 2021d, 'Agronomy', accessed February 15, 2022, from <https://www.srif.net.fj/page9.html#content4-7a>.

Stake, RE 2005, 'Case studies', in NK Denzin & Y Lincoln (eds), *The Sage Handbook of Qualitative Research*, SAGE Publications, pp. 433–466.

Sterk, M, van de Leemput, IA & Peeters, ET 2017, 'How to conceptualize and operationalise resilience in socio-ecological systems?', *Current Opinion in Environmental Sustainability*, vol. 28, pp. 108–113.

Stott, C & Huq, S 2014, 'Knowledge flows in climate change adaptation: Exploring friction between scales', *Climate and Development*, vol. 6, no. 4, pp. 382–387.

Stringer, LC, Fraser, EDG, Harris, D, Lyon, C, Pereira, L, Ward, CFM & Simelton, E 2020, 'Adaptation and development pathways for different types of farmers', *Environmental Science and Policy*, vol. 104, no. August 2019, pp. 174–189.

Surminski, S & Lopez, A 2014, 'Concept of loss and damage of climate change-a new challenge for climate decision-making? A climate science perspective', *Climate and Development*, vol. 7, no. 3, pp. 267–277.

Tabe, T 2019, 'Climate change migration and displacement: Learning from past relocations in the Pacific', *Social Sciences*, vol. 8, pp. 1–18.

Talakia, M 2015, *Loss and damage gap analysis from climate change Vanuatu country report*, accessed May 27, 2019, from <https://unfccc.int/files/adaptation/groups_committees/loss_and_damage_executive_committee/application/pdf/gap_analysis_on_loss_and_damage_from_climate_change-final_vanuatu_report.pdf>.

Tavory, I & Timmermans, S 2009, 'Two cases of ethnography. Grounded theory and the extended case method', *Ethnography*, vol. 10, no. 3, pp. 243–263.

Taylor, M, McGregor, A & Dawson, B 2016, *Vulnerability of Pacific Island agriculture and forestry to climate change*, Noumea Cedex, accessed August 26, 2019, from <https://www.spc.int/sites/default/files/wordpresscontent/wp-content/uploads/2016/12/Vulnerability-of-Pacific-Island-agriculture-and-forestry-to-climate-change.pdf>.

Teddlie, C & Tashakkori, A 2009, *Foundations of mixed methods research : integrating quantitative and qualitative techniques in the social and behavioral science* C Teddlie (ed), Thousand Oaks: Sage Publications.

Termeer, C, Dewulf, A & Biesbroek, R 2017, 'Transformational change: governance interventions for climate change adaptation from a continuous change perspective', *Journal of Environmental Planning and Management*, vol. 60, no. 4, pp. 585–576.

Terry, J 2005, 'Hazard warning! Hydrological responses in the Fiji Islands to climate variability and severe meteorological events', *Regional Hydrological Impacts of Climatic Change—Hydroclimatic Variabilit*, vol. 296, pp. 33–41.

Terry, JP & Raj, R 2014, 'The 1997-98 El Nino and drought in the Fiji Islands', *Second International Colloquium on Hydrology and Water Management in the Humid Tropics*, vol. 80–93, no. November.

The Fijian Government 2020, 'Supporting the Sugar Industry', accessed December 28, 2022, from <https://www.fiji.gov.fj/Media-Centre/News/SUPPORTING-THE-SUGAR-

INDUSTRY-CRUCIAL-PM-BAINIMARA >.

The Government of Fiji 2016, *Fiji Budget Estimates 2016*, Fiji.

The Government of Fiji 2018, *National Disaster Risk Reduction Policy 2018 – 2030, The Republic of Fiji Islands*, Suva, Fiji.

The Government of Fiji 2019a, 'The Sugar Industry Act 1984', accessed July 17, 2021, from <https://www.laws.gov.fj/Acts/DisplayAct/422#>.

The Government of Fiji 2019b, 'The Sugar Industry Act', accessed May 18, 2021, from <https://www.laws.gov.fj/Acts/DisplayAct/422#>.

The Government of Fiji 2020, *Republic of Fiji. Budget estimates 2020-2021*, Suva, Fiji.

The World Bank 2018, *Climate vulnerability assessment. Making Fiji climate resilient*, accessed August 6, 2019, from <https://reliefweb.int/sites/reliefweb.int/files/resources/fiji.pdf>.

The World Bank 2019, 'Fiji Issues first developing country Green Bond, raising $50 Million for climate resilience', accessed October 9, 2019, from <https://www.worldbank.org/en/news/press-release/2017/10/17/fiji-issues-first-developing-country-green-bond-raising-50-million-for-climate-resilience>.

Thomas, A, Baptiste, A, Martyr-Koller, R, Pringle, P & Rhiney, K 2020, 'Climate change and small island developing states', *Annual Review of Environment and Resources*, vol. 45, pp. 1–27.

Thomas, A & Benjamin, L 2018a, 'Management of loss and damage in small island developing states: Implications for a 1.5 °C or warmer world', *Regional Environmental Change*, vol. 18, no. 8, pp. 2369–2378.

Thomas, A & Benjamin, L 2018b, 'Policies and mechanisms to address climate-induced migration and displacement in Pacific and Caribbean small island developing states', *International Journal of Climate Change Strategies and Management*, vol. 10, no. 1, pp. 86–104.

Thomas, A & Benjamin, L 2018c, 'Policies and mechanisms to address climate-induced migration and displacement in Pacific and Caribbean small island developing states', *International Journal of Climate Change Strategies and Management*, vol. 10, no. 1, pp. 86–104.

Thomas, A & Benjamin, L 2020, 'Non-economic loss and damage: Lessons from displacement in the Caribbean', *Climate Policy*, vol. 20, no. 6, pp. 715–728, accessed from <https://doi.org/10.1080/14693062.2019.1640105>.

Thomas, A, Mangubhai, S, Vandervord, C, Fox, M & Nand, Y 2018, 'Impact of tropical cyclone Winston on women mud crab fishers in Fiji', *Climate and Development*, vol. 11, no. 8, pp. 699–709.

Thomas, DR 2006, 'A general inductive approach for analyzing qualitative evaluation data', *American Journal of Evaluation*, vol. 27, no. 2, pp. 237–246.

Toussaint, P & Blanco, AM 2019, 'A human rights-based approach to loss and damage under the climate change regime', accessed August 22, 2019, from <https://www.tandfonline.com/action/journalInformation?journalCode=tcpo20>.

Traore, S & Owiyo, T 2013, 'Dirty droughts causing loss and damage in Northern Burkina Faso', *International Journal of Global Warming*, vol. 5, no. 4, p. 498.

Trnka, S 2005, 'Land, life and labour: Indo-Fijian claims to citizenship in a changing Fiji', *Oceania*, vol. 75, no. 4, pp. 354–367.

Tschakert, P, Barnett, J, Ellis, N, Lawrence, C, Tuana, N, New, M, Elrick-Barr, C, Pandit, R & Pannell, D 2017, 'Climate change and loss, as if people mattered: values, places, and experiences', *Wiley Interdisciplinary Reviews: Climate Change*, vol. 8, no. 5, pp. 1–19.

Tschakert, P, Ellis, N, Anderson, A, Kelly, A & Obeng, J 2019, 'One thousand ways to experience loss: A systematic analysis of climaterelated intangible harm from around the world', *Global Environmental Change*, vol. 55, pp. 58–72.

Tschakert, P, Ellis, N, Anderson, C, Kelly, A & Obeng, J 2019, 'One thousand ways to experience loss: A systematic analysis of climate-related intangible harm from around the world', *Global Environmental Change*, vol. 55, pp. 58–72

UNDP 2017, *Financing the SDGs in the Pacific islands: Opportunities, challenges and ways forward*, UNDP.

UNDRR 2019, *Disaster risk reduction in the Republic of Fiji*, Bangkok.

UNDRR 2021, 'New insurnace product to fight against climate change in the Pacific', accessed June 15, 2022, from <https://www.preventionweb.net/news/new-insurance-product-aid-fight-against-climate-change-pacific>.

UNEP 2018, *Adaptation gap report 2018*, accessed from <https://www.unenvironment.org/resources/adaptation-gap-report>.

UNESCO 2017, *Community-based loss and damage assesment toolkit for the tourism and agricultural sector*, Fiji.

UNFCCC 1992, *United Nations Framework Convention on Climate Change*, accessed April 24, 2019, from <https://unfccc.int/resource/docs/convkp/conveng.pdf>.

UNFCCC 2008, *Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007*, accessed May 2, 2019, from <https://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf>.

UNFCCC 2011a, *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010*, accessed May 2, 2019, from <https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf>.

UNFCCC 2011b, *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010*, accessed May 27, 2019, from <https://unfccc.int/sites/default/files/resource/docs/2010/cop16/eng/07a01.pdf>.

UNFCCC 2012a, *A literature review on the topics in the context of thematic area 2 of the work programme on loss and damage: a range of approaches to address loss and damage associated with the adverse effects of climate change*, accessed May 2, 2019, from <https://unfccc.int/resource/docs/2012/sbi/eng/inf14.pdf>.

UNFCCC 2012b, *Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011*,.

UNFCCC 2014, *Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013*, accessed May 27, 2019, from <https://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf>.

UNFCCC 2015a, *Paris Agreement*, accessed May 28, 2019, from <https://unfccc.int/sites/default/files/english_paris_agreement.pdf>.

UNFCCC 2015b, *Report of the Conference of the Parties on its twentieth session, held in Lima from 1 to 14 December 2014*, accessed May 27, 2019, from <https://unfccc.int/resource/docs/2014/cop20/eng/10a02.pdf>.

UNFCCC 2016a, *Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015*, accessed from <https://unfccc.int/sites/default/files/english_paris_agreement.pdf>.

UNFCCC 2016b, *Report of the Executive Committee of the Warsaw International Mechanism for loss and damage associated with climate change impacts*, accessed May 9, 2019, from <https://unfccc.int/resource/docs/2016/sb/eng/03.pdf>.

UNFCCC 2017, 'Message from the Incoming COP 23 President Prime Minister Frank Bainimarama of Fiji', accessed July 4, 2022, from <https://unfccc.int/news/message-from-the-incoming-cop-23-president-prime-minister-frank-bainimarama-of-fiji#:~:text=Fiji assumes the Presidency of,at COP 22 in Marrakesh.>.

UNFCCC 2018a, *Report of the Conference of the Parties on its twenty-third session, held in Bonn from 6 to 18 November 2017*, accessed May 28, 2019, from <http://unfccc.int/9985.>.

UNFCCC 2018b, *Preparations for the implementation of the Paris Agreement and the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement*, accessed May 31, 2019, from <https://unfccc.int/sites/default/files/resource/Informal Compilation_proposal by the President_rev.pdf>.

UNFCCC 2018c, 'Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM)', accessed January 11, 2021, from <https://unfccc.int/topics/adaptation-and-resilience/workstreams/loss-and-damage-ld/warsaw-international-mechanism-for-loss-and-damage-associated-with-climate-change-impacts-wim#eq-3>.

UNFCCC 2018d, *Report of the Suva Expert Dialogue*, accessed May 28, 2019, from <https://unfccc.int/sites/default/files/resource/SUVA Report_ver_13_Nov.pdf>.

UNFCCC 2019a, *Elaboration of the sources of and modalities for accessing financial support for addressing loss and damage*,.

UNFCCC 2019b, *Conference of the Parties serving as the meeting of the Parties to the Paris Agreement Second session Madrid, 2–13 December 2019. Agenda item 6 Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts*,.

UNFCCC 2019c, *Terms of Reference for the technical paper elaborating the sources of financial support , as provided through the Financial Mechanism for addressing loss and damage , finance available for addressing loss and damage outside the Financial Mechanism , as we*,.

UNFCCC 2021a, 'Non economic loss', accessed March 22, 2021, from <https://unfccc.int/wim-excom/areas-of-work/non-economic-losses>.

UNFCCC 2021b, 'Introduction to climate finance', accessed February 4, 2021, from <https://unfccc.int/topics/climate-finance/the-big-picture/introduction-to-climate-finance>.

UNFCCC 2021c, 'CMA3 - Glasgow Climate Pact', *Cma3*, pp. 1–11.

UNFCCC 2022, 'Funding arrangements for responding to loss and damage associated with the

adverse effects of climate change, including a focus on addressing loss and damage', accessed December 22, 2022, from https://unfccc.int/documents/624440

United Nations News 2022, 'COP27 closes with deal on loss and damage: 'A step towards justice', says UN Chief', accessed December 22, 2022, from https://news.un.org/en/story/2022/11/1130832

United Nations Office for Disaster Risk Reduction 2015, *Sendai framework for disaster risk reduction 2015 - 2030*, accessed May 9, 2019, from <https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf>.

UNOCHA 2003, 'Fiji - Cyclone Ami OCHA Situation Report No. 3', accessed August 14, 2019, from <https://reliefweb.int/report/fiji/fiji-cyclone-ami-ocha-situation-report-no-3>.

Vanhala, L, Robertson, M & Calliari, E 2021, 'The knowledge politics of climate change loss and damage across scales of governance', *Environmental Politics*, vol. 30, no. 1–2, pp. 141–160.

Veitayaki, J 2010, 'Climate change adaptation issues in small island developing states', *Community, Environment and Disaster Risk Management*, vol. 4, pp. 369–391.

Verheyen, R & Roderick, P 2008, *Beyond adaptation. The legal duty to pay compensation for climate change damage.*, accessed May 30, 2019, from <http://assets.wwf.org.uk/downloads/beyond_adaptation_lowres.pdf>.

Vermeulen, SJ, Dinesh, D, Howden, SM, Cramer, L & Thornton, PK 2018, 'Transformation in practice: A review of empirical cases of transformational adaptation in agriculture under climate change', *Frontiers in Sustainable Food Systems*, vol. 2, no. October.

Voigt, C 2008, 'State responsibility for climate change damages', *Nordic Journal of International Law*, vol. 77, no. 1–2, pp. 1–22.

Wairiu, M 2017, 'Land degradation and sustainable land management practices in Pacific Island Countries', *Regional Environmental Change*, vol. 17, no. 4, pp. 1053–1064.

Wallimann-Helmer, I 2015, 'Justice for climate loss and damage', *Climatic Change*, vol. 133, no. 3, pp. 469–480.

Wallimann-Helmer, I, Meyer, L, Mintz-Woo, K, Schinko, T & O, S 2018, 'The ethical challenges in the context of climate loss and damage', in *Loss and damage from climate change. Concepts, methods and policy options*, Springer, pp. 39–62.

Wang, Y jie, Huang, J kun & Wang, J xia 2014, 'Household and community assets and farmers' adaptation to extreme weather event: The case of drought in china', *Journal of Integrative Agriculture*, vol. 13, no. 4, pp. 687–697.

Waqaicelua, A, Vuniyayawa, V, Kumar, R, Daphne, A & Prakash, B 2011, *Chapter 5: Fiji Islands. Climate change in the Pacific. Volume 2: Country reports*, accessed August 6, 2019, from <https://www.pacificclimatechangescience.org/wp-content/uploads/2013/09/Fiji.pdf>.

Waqainabete-Tuisese, S 2016, *Better farming and ranching practises in Ra Province-Diagnosis an Action Plan,*.

Warner, K & Afifi, T 2014, 'Where the rain falls: Evidence from 8 countries on how vulnerable households use migration to manage the risk of rainfall variability and food insecurity', *Climate and Development*, vol. 6, no. 1, pp. 1–17.

Warner, K & van der Geest, K 2013, *Loss and damage from climate change: Local-level evidence from nine vulnerable countries*, accessed April 24, 2019, from

<https://pdfs.semanticscholar.org/558c/4da307b015b26425c809fd8604a81631e9b0.pdf>
.

Warner, K, Van Der Geest, K, Kreft, S, Huq, S, Harmeling, S, Kusters, K & De Sherbinin, A 2012, *Loss and damage in vulnerable countries. Initiative evidence from the frontlines of climate change: Loss and damage to communities despite coping and adaptation*, United Nations University.

Warrick, O, Aalbersberg, W, Dumaru, P, Mcnaught, R & Teperman, K 2017, 'The "Pacific Adaptive Capacity Analysis Framework": Guiding the assessment of adaptive capacity in Pacific island communities', *Regional Environmental Change*, vol. 17, pp. 1039–1051, accessed May 9, 2019, from <https://link-springer-com.proxy.library.adelaide.edu.au/content/pdf/10.1007%2Fs10113-016-1036-x.pdf>.

Webb, NP, Marshall, NA, Stringer, LC, Reed, MS, Chappell, A & Herrick, JE 2017, 'Land degradation and climate change: Building climate resilience in agriculture', *Frontiers in Ecology and the Environment*, vol. 15, no. 8, pp. 450–459.

Weber, E 2016, 'Water in the Pacific Islands: Case studies from Fiji and Kiribati', in *Water. A Source of conflict or cooperation*, pp. 269–309, accessed from <http://www.scipub.net>.

Westoby, R, Clissold, R, McNamara, KE, Latai-Niusulu, A & Chandra, A 2022, 'Cascading loss and loss risk multipliers amid a changing climate in the Pacific Islands', *Ambio*, vol. 51, no. 5.

Wewerinke-Singh, M & Salili, DH 2019, 'Between negotiations and litigation: Vanuatu's perspective on loss and damage from climate change', *Climate Policy*, vol. 20, no. 6, pp. 1–12.

Whitbeck, L 2006, *Options and aid: What the future holds for the displaced sugarcane families of Labasa, Fiji*, Fiji.

Willis, JW, Jost, M & Nilakanta., R 2007, *Foundations of qualitative research : Interpretive and critical approaches*, SAGE Publications.

Winterford, K & Gero, A 2018, *Humanitarian response for development: Lessons from Tropical Cyclone*, accessed from <http://pubs.iied.org/17472IIED>.

Wolf, J & Moser, SC 2011, 'Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world', *Advanced Review*, vol. 2, no. 547–567.

World Bank Group 2019, 'Fiji country context', accessed August 13, 2019, from <https://climateknowledgeportal.worldbank.org/country/fiji>.

Wrona, T & Gunnesch, M 2016, 'The one who sees more is more right: how theory enhances the "repertoire to interpret" in qualitative case study research', *Journal of Business Economics*, vol. 86, no. 7, pp. 723–749.

Yaffa, S 2013, 'Coping measures not enough to avoid loss and damage from drought in the North Bank Region of The Gambia', *International Journal of Global Warming*, vol. 5, no. 4, pp. 467–482, accessed from <http://www.inderscience.com/link.php?id=57286>.

Yazan, B 2016, 'Three approaches to case study methods in education: Yin, Merriam, and Stake', *The Qualitative Report*, vol. 20, no. 2, pp. 134–152.

Yila, O, Weber, E & Neef, A 2013, *The role of social capital in post-flood response and recovery among downstream communities of the BA river, Western Viti Levu, Fiji Islands*, Emerald Group Publishing Limited, accessed from

<http://dx.doi.org/10.1108/S2040-7262(2013)0000014010>.

Yilmaz, K 2013, 'Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences', *European Journal of Education*, vol. 48, no. 2, pp. 311–325.

Yin, RK 2003, *Case study research : Design and methods* Third Edit., SAGE Publications.

Zellentin, A 2015a, 'Climate justice, small island developing states and cultural loss', *Climatic Change*, vol. 133, no. 3, pp. 491–498.

Zellentin, A 2015b, 'Climate justice, small island developing states & cultural loss', *Climatic Change*, vol. 133, pp. 491–498.

Zhao, D & Li, YR 2015, 'Climate change and sugarcane production: Potential impact and mitigation strategies', *International Journal of Agronomy*, vol. 2015.

Zhongwei, X 2015, 'Agriculture and rural development: The case of Fiji', accessed August 5, 2019, from <https://mro.massey.ac.nz/bitstream/handle/10179/7412/02_whole.pdf?sequence=2&isAllowed=y>.

Ziervogel, G 2019, 'Building transformative capacity for adaptation planning and implementation that works for the urban poor: Insights from South Africa', *Ambio*, vol. 48, no. 5, pp. 494–506.