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Can Circular Economy Advance Pacific SIDS SDG and NDC Targets While Maintaining Self-Determination? A Mixed Methods Approach

A thesis with publication presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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Abstract

This study explored whether circular economy (CE) strategies could advance the Sustainable Development Goals (SDGs) and Nationally Determined Contributions (NDCs) in Pacific Small Island Developing States (SIDS) while upholding self-determination. It contributes to the field of sustainable transition (ST) by addressing three interlinked areas of enquiry: (i) Objective 1 identified that while CE activities existed in Pacific SIDS, they remained fragmented and unsupported by cohesive policy frameworks; (ii) Objective 2 conducted the first Economy-Wide Material Flow Analysis (EW-MFA) for Tonga, which revealed zero percent circularity and structural inefficiencies; and (iii) Objective 3 introduced the Indigenous Triple Helix (I-TH) model, a culturally grounded framework rooted in Pacific governance and knowledge systems, as a context-specific pathway for ST.

The first study employed a mixed-methods approach to examine CE adoption in Samoa, the Cook Islands, and Tonga, focusing on local institutions and transition policies. Using the Ellen MacArthur Foundation's Butterfly Diagram and institutional coevolutionary analysis, the research found that community-led initiatives such as biogas and solar projects in Samoa and the Cook Islands more effectively advanced sustainability goals. In contrast, Tonga's top-down strategies struggled with efficiency and long-term viability.

The second employed EW-MFA for Tonga to address a measurement gap. Results revealed high dependence on imported fossil fuels and biomass products, underscoring the need for context-specific CE strategies reflective of local material and energy use patterns, illustrated by Samoa's decentralised biomass energy initiative.

The final study undertook a conceptual analysis by developing the I-TH model, adapting the Triple Helix framework (Etzkowitz & Leydesdorff, 1998, 2000) to Pacific Indigenous contexts. While the original model emphasised collaboration among government, academia, and industry, the I-TH reframed development through the interwoven authorities of spiritual governance (God), kinship-based land stewardship (People and Land), and heritage preservation (Inheritance).

Collectively, the three studies showed that while CE could support SDG and NDC objectives, their success in Pacific SIDS depended on embedding strategies within Indigenous governance systems. By extending CE thinking through a culturally grounded lens, the thesis contributes more broadly to the global field of ST, where advancing self-determination is essential to achieving climate goals under the Paris Agreement.

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To my husband, Trevor, mālō ‘aupito - for your sacrifices and unwavering support. To our children, Chris and Emma, your encouragement and love have been my greatest motivation.

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From the bottom of my heart, thank you all.

Dedication

With deepest respect, this humble work is dedicated to the memory of Her Late Majesty Queen Halaevalu Mataʻaho, the Queen Mother of Tonga



Malu e fuka, ke u hūfanga;
Aoniu, ʻikai hano ngataʻanga.
Ka u unga he tala ʻo e fonuá,
Tulou Kamoto mo Teá,

Taking cover under the flag's shade;
Absolute, eternal.
That I shelter in the nation's tradition,
May I pass, Kamoto and Tea.

***A**u e! he langi taukakapa,*
Tuʻula ʻi he ʻOtumotu, Fanga.
Hāʻunga faka-Fevanga,
Lī e ʻoá pea fakamaha.

Alas! the far-reaching skies,
Descending on the Bay of Islands.
The reception is that of Fevanga —
Cast the creel, with its all.

ʻA e ʻAta ko hoku kakala;
Tukuloto ko e laukaʻanga,
Siú na kuo taka ʻi Maʻananga,
Ko ʻeku koloa ʻi Maama.

The shadow, my garland,
Concealed as pride.
The journey, though in afterlife,
Is treasured here on earth.

Tongi, kuo tau ho langí!
Louveve ʻo Tavahi.
Ke talia haʻo ʻamanaki,
He kuo papa ʻa e halá ni.

Tongi, your tune climaxes thus,
Fallen leaves of Tavahi,
To wait upon your wishes —
A well-trodden path.

***A**u e! he langi taukakapa,*
Tuʻula ʻi he ʻOtumotu, Fanga.
Hāʻunga faka-Fevanga,
Lī e ʻoá pea fakamaha.

Alas! the far-reaching skies,
Descending on the Bay of Islands.
The reception is that of Fevanga —
Cast the creel, with its all.

Preface

This work was conceived from a realisation later in my research pursuit: the vital role that cultural practices and customs play in enabling Pacific societies. Undermining these elements forfeits undiscovered societal potential and valuable cultural utilities and epistemologies essential for addressing global challenges.

This journey commenced in June 2018, upon an appointment as Training and Development Advisor for the Cook Islands Tertiary Training Institute, under the auspices of New Zealand Volunteer Services Abroad (VSA). The Cook Islands, a tropical paradise, enjoys a unique economic standing, buoyed by its popularity as a tourist destination. Home to approximately 17,000 inhabitants, this 237-square-kilometer archipelago with fifteen islands, had an effective waste management system at first glance.

Arriving on the island, greeted by an environment both eerily familiar and distinctly foreign, the climate and people bore a resemblance to the author's native Tonga, yet differences in language, customs, and even the organisation of gardens highlighted a subtle dissonance. This sense of alienation was soon alleviated by the warmth of the landlords, who also happened to be key players in the island's recycling and transportation sectors.

The ensuing interactions and the hospitality exchanged opened avenues to a need for developmental funding to bolster the island's recycling initiatives. Collaboratively, a drafted Concept statement for the Green Climate Fund (GCF) was approved by the local National Designated Authority (NDA). To prepare the Concept statement for the GCF Preparation

Facility, the NDA advised to formulate the proposal on the basis of *circular economy*. However, the unforeseen advent of Covid-19 halted the efforts, propelling this endeavour towards pursuing doctoral research to delve deeper into circular economy, a concept trajectory proposed by the Cook Islands NDA.

Six years have elapsed since the inception of this endeavour, marked by significant global and personal changes. The pandemic underscored the imperative for heightened environmental consciousness and hastened global actions against climate change. Through this thesis, the author aspires to bridge the gap between cultural understanding and environmental action, offering insights and solutions that honour the resilience and spirit of Pacific Peoples and extend hope and strategies to broader communities worldwide.

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CHAPTER 1

Introduction

1.1. From linear dependency to circular resilience

Current efforts by the Pacific small island developing states (SIDS) towards sustainable development goals (SDGs) as defined by the United Nations General Assembly (2015), are embedded in the old linear economic paradigm of "take-make-dispose," described by the Ellen MacArthur Foundation (EMF, 2013). These SIDS have been observed to have relatively high import levels (UNCTAD, 2021), which result in an environmentally counterproductive "end-of-life" treatment of imported materials. In parallel with their SDG efforts, Pacific SIDS are also committed to the Paris Agreement (PA) targets, formalised through the five-yearly Nationally Determined Contributions (NDCs; United Nations, 2015). It is crucial to synchronise these two agendas to minimise overlap, enhance productivity, and optimise resource use, while bolstering technical capabilities and fostering the exchange of knowledge and skills (UNDP, 2017, p. 3).

The circular economy (CE) is an economic model that aims to eliminate waste and keep resources in use for as long as possible. It has emerged as a central concept to "decouple economic growth from consumption of finite resources and build economic, natural and social capital" (EMF, 2019). A brief exploration of the historical development and background to legitimise CE provides important context for the following discussion. The Stockholm Declaration (Secretariat of the United Nations, 1972) laid the foundation for Environmental Law and arguably marked a pivot away from *free-market* (Van der Lugt, 2002; Ekins, 1993) economic models, introducing a new discourse (Foucault, 1972). Proclamation 6 of the

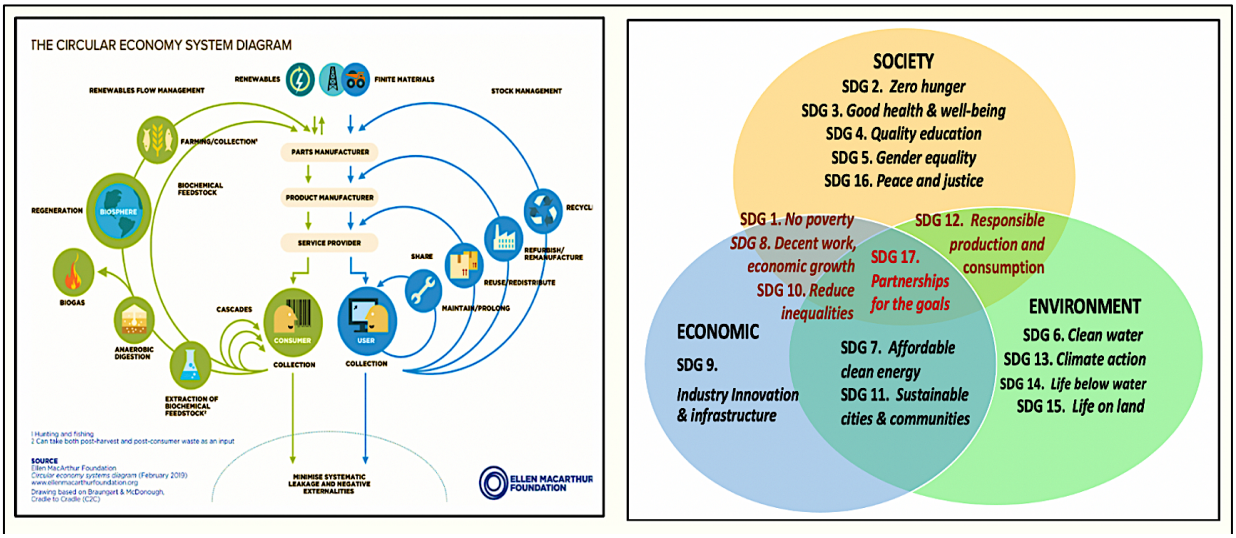
declaration calls for humans to act with prudent care for the environment, while Proclamation 7 emphasises that every individual, institution, and government worldwide must accept responsibility under environmental law.

On the basis of the global environmental mandate, traditional demand and supply theories are increasingly implicated in the shift towards the CE model. Stahel (2016) explains this transition as ownership giving way to stewardship. Circularity, as a key performance metric, is gaining traction as an essential measure of progress alongside traditional metrics such as gross domestic product, which, while limited in its environmental scope, remains a foundational economic indicator. As sustainable development (SD) calls for a balance of economic, environmental, and social outcomes (Mensah, 2019; Purvis et al., 2019), the global economic paradigm is increasingly turning towards metrics that reflect resource efficiency and environmental stewardship. Economy-Wide Material Flow Analysis (EW-MFA[1]) is one such metric and accordingly forms the basis for the material flow analysis presented in this study. Nonetheless, some scholars argue that the development discourse itself remains fundamentally incompatible with traditional economic principles, leading to unresolved contradictions (Ziai, 2016). Kirchherr et al. (2023) noted in one of their findings that questions linger on whether CE can effectively balance environmental sustainability and economic development.

In the meantime, terms such as "linear economy" were introduced to distinguish the outcomes of the old economic paradigm from the emerging "CE." Industrialised nations, spearheaded by the EMF, embraced the CE concept and promoted it as a viable pathway for meeting their PA targets on sustainability and carbon reduction.

[1] *Economy-wide material flow accounting* (EW-MFA) formally refers to accounting, though the term is also commonly used to denote material flow analysis when applied in research contexts.

Figure 1.1. Circular Economy Framework & 17 Sustainable Development Goals



Source: EMF CE framework[2] and the SDGs classified under the three Pillars (author's construct)

Figure 1.1 juxtaposes the EMF CE System Diagram with the seventeen SDGs, which are grouped under the three pillars (Purvis et al., 2019), purported to uphold these goals. Each SDG includes targets, amounting to a total of 169. Ortiz-de-Montellanoa et al. (2023) analysed the potential impact of circularity strategies on the 17 SDGs and their 169 targets. They found that CE strategies can contribute to all SDGs, with the strongest impact on SDGs 8, 12, and 13, and the weakest on SDGs 4, 5, 10, and 16 due to the increasing role of the CE in research, policy, and business. Other studies have also connected the utility of CE to SDGs (Dantas et al., 2021; Schroeder et al., 2019; Rodriguez-Anton et al., 2019).

Taken together, while CE is a potentially transformative concept, the conceptualisation, policies, and practices associated with CE and the SDGs remain open to interpretation. Member countries of the Organisation for Economic Co-operation and Development have implemented CE policies since 2015, with the EMF notably publishing influential papers in 2013 and 2015, which sparked a significant increase in academic CE literature (Geissdoerfer, et al., 2017). Pacific

[2] The EMF CE diagram is provided here for contextual purposes. The full reproduction and use authorisation of the EMF CE diagram is given on page 44.

SIDS' proactive alignment with CE is posited here as necessary for CE to be effective and, most importantly, to serve Pacific SIDS's SD solutions and their self-determination.

Given the attention drawn to CE in the introductory discussion, and as noted in the Preface regarding the author's direct engagement with the National Designated Authority (NDA) of the Cook Islands, it was not surprising that the NDA expressed confidence that a CE proposal for the Green Climate Fund (GCF) would improve the likelihood of securing finance. Similarly, around the same time, Tonga launched its CE Biomass Energy GCF Facility application (Ma'u, 2019). As the author of the Cook Islands GCF Waste Management *Concept* (CIGT Ltd., 2019), the need for CE's application in Pacific SIDS became evident. Through a review of the literature, the central question of this research was established: *Can the CE advance Pacific SIDS' SDG and NDC targets?* Three SIDS were identified: Samoa, Tonga, and the Cook Islands (rationale given in Section 1.3).

To develop the research question, this thesis engaged in a co-creation approach in which stakeholders from Pacific SIDS were invited to participate in shaping its direction. A topic co-creation exercise (Pearce et al., 2020; Fitzpatrick et al., 2023) was initiated. An invitation letter was sent to the NDAs in Samoa, Tonga, and the Cook Islands, followed by a reminder. Only Tonga's incumbent agreed to participate in the exercise. Through this engagement it was determined that permission was required to conduct research in Tonga; approval was accordingly obtained (see Appendix). While the Cook Islands NDA was unavailable for comment, their views and commitment to CE were well-known to the author and, as noted earlier, Cook Islands was the catalyst for this study.

Given the lack of response from Samoa's NDA, a respected Samoan Elder, Va‘ai, was engaged as a cultural contact to facilitate understanding and connection within the community. Va‘ai, a Matai (chief) from a business family with tertiary lectureship and government experience, provided a valuable balance of cultural insight and professional expertise.

Through the co-creation stage and supporting literature, the theme of self-determination emerged. SD, as an international set of economic and moral directives with significant financial influence (evident in the increase of foreign grants in national budgets), necessitated the consideration of an additional dimension to the study. Consequently, the research established its primary aim: to examine whether the CE can advance Pacific SIDS SDG and NDC targets while maintaining self-determination.

To address this overarching research question, a series of studies were conducted, as outlined in Table 1.1. Collectively, these studies contribute to the field of Indigenous SIDS development and sustainable transition (ST).

The empirical studies are presented in Chapters 2 and 4 and address Objectives 1 and 2, respectively. Chapter 2 diagnoses circular economy progress and institutional conditions across Samoa, Tonga, and the Cook Islands, while Chapter 4 measures circularity through an economy-wide material flow analysis of Tonga. Chapters 3 and 5 develop matters arising from these empirical studies, while Chapter 6 addresses Objective 3 through the development of the Indigenous Triple Helix framework.

Table 1.1. Research question and objectives

Objective 1 **Chapter 2** *A stocktake of CE progress and strategy in Pacific SIDS: An Institutional Coevolutionary Analysis.*	**Matters arising 1:** **Chapter 3** Emerging themes from Objective 1. *Are SD policies enabling or are they threats to self-determination?* *Final Publication Version: Beyond the Three Pillars: A Tongan Indigenous Reframing of Sustainable Development*	**Objective 2** **Chapter 4** *An EW-MFA for Tonga: Circularity and the Challenges of ST in a Pacific SIDS.*	**Matters arising 2:** **Chapter 5** Emerging themes from Objective 2. *Harmonious Layers of Social Wellness: Unravelling the Russian Doll of Socioeconomic Metabolism, Social Capital and Social Wellbeing.*	**Objective 3** **Chapter 6** *Indigenous Resilience and Self-Determination for ST: A Pacific SIDS Model*
Dissemination	**Dissemination**	**Dissemination**	**Dissemination**	**Dissemination**
On Sustainability Conference *and* The International Journal of Social Sustainability in Economic, Social, and Cultural Context*	DevNet** Conference *and* Tonga Research Association Conference AlterNative: An International Journal of Indigenous Peoples***	ANZRSAI**** Conference *and* APSDJ† by the Economic and Social Commission for Asia and the Pacific (ESCAP)	International Tongan Nurses Association Conference; 28th Pacific Conference of the RSAI (PRSCO 2026) *and* Australasian Journal of Regional Studies (AJRS) ††	PIPSA††† Conference *and* Springer Nature, PIPSA Book project (Chapter 6).
Conference date: 1-3 Feb. 2023 *Publication date:* 14 May 2024	***Conference dates:*** 7-9 Dec. 2022 7 July 2023 *Submission date:* 22 June 2026	***Conference date:*** 1-2 Dec. 2025 *Publication date:* 22 December 2025	***Conference dates*:** 17-20 Aug. 2023 1-3 Dec. 2026 *Submission date:* 30 July 2026	***Conference date:*** 20-21 Feb. 2025 *Expected publication:* Q3 2026

* Published by Common Ground Research Network, DOI: 10.18848/2325-1115/CGP/v20i01/137-168
** DevNet – Aotearoa New Zealand International Development Studies Network
*** AlterNative: An International Journal of Indigenous Peoples – currently under review
**** ANZRSAI - Australia and New Zealand Regional Science Association International Inc**.**
† APSDJ – Asia-Pacific Sustainable Development Journal, DOI: https://doi.org/10.18356/26178419-32-2-13
†† AJRS – Australasian Journal of Regional Science.
††† PIPSA – Pacific Islands Political Studies Association. PIPSA and Springer Nature book, in print, Chapter 6: *Charting the Blue Economy: Lessons from and Recommendations for Pacific Island Countries*.

1.2. Literature review

1.2.1. Orientation: Situating the CE within ST

This subsection provides an orienting, systems-based synthesis, foregrounding the CE and clarifying its relationship to ST. Its purpose is to position the thesis and supply a shared conceptual frame for the constituent publications, not to reproduce chapter-level literature reviews. From a systems perspective, ST is treated as the overarching field within which the CE is nested; change is conceptualised as a dynamic interplay among social, technological, institutional, and environmental domains. Rather than developing them as standalone topics, it references key ST lenses, such as Multi-Level Perspective (MLP), alongside concepts of actors and agency, non-technical values, resilience, and experimentation, to signal the perspective informing subsequent chapters. The subsection locates the work within the global discourse on ST and CE, with specific relevance to Pacific SIDS and alignment with PA. Detailed scholarly discussions and empirical literature are explored in the relevant chapters.

Sustainability Transitions: Theoretical and Systemic Framing

ST involve long-term, fundamental reconfigurations of socio-technical systems to address intertwined environmental, economic, and social challenges (Geels, 2014). At the heart of transition studies lies the *MLP,* which conceptualises change as the interplay between *niche innovations*, dominant socio-technical *regimes*, and external *landscape pressures* (Geels & Schot, 2007). Geels and Turnheim (2022), in *The Great Reconfiguration*, extend this framework to analyse low-carbon transitions in electricity, heat, and mobility systems, emphasising that coordinated action across technological, behavioural, and institutional domains is necessary to achieve sustainable outcomes.

While the MLP provides a robust structural lens, its limitations, particularly its emphasis on technological systems, have been noted. Geographic perspectives highlight how local institutional frameworks, cultural dynamics, and resource constraints shape transition pathways (Hansen and Coenen, 2015), and Political/justice-oriented work urge explicit engagement with power and contestation (Meadowcroft, 2011; Avelino et al., 2016). These concerns are salient for Pacific SIDS, where socio-ecological specificities and relational governance arrangements necessitate place-based, cultural embedded pathways.

The Role of Non-Technical Disruptions

The evolution of transition research highlights the increasing importance of *non-technical disruptions* in enabling systemic change. Kivimaa et al. (2019) argue that progress in transition studies requires moving beyond traditional market, policy, and actor-focused approaches to include disruptions in *behaviour, practices, and cultural models*. While this framing is influential (Geels, 2002, Köhler et al., 2019), Pacific scholarship indicates that behaviour, practices and cultural models constitute foundational enabling conditions for sustainability transitions (Thaman, 2019a, p. 15; Thaman, 2000, p. 30; Vea-Simpson, 2024). Accordingly, the present study examines Pacific SIDS through knowledge systems and values, for example, social-spatial relations as well as land and oceanic relationality, attending to cultural norms, relational governance, and behavioural adaptations as the social fabric that makes systemic change possible (Hauʻofa, 1994; Kaʻili, 2017; Thaman, 2019a) and essential to cultural legitimacy in transition pathways (Meadowcroft, 2011; Scoones et al., 2015).

Actors and Agency in Transitions

Understanding ST necessitates a focus on *actors and agency.* Fischer and Newig (2016) propose a visibility typology that clarifies actors' role across three dimensions: i) *Systemic* -

actors across niches, regimes, and landscapes (MLP); ii) *Institutional* - state, market, and civil society actors; and iii) *Governance* - actors at local, regional, national, and global levels, including intermediaries. This typology clarifies the multi-scalar governance processes necessary for enabling ST. Complementary work elaborates roles and power dynamics among intermediaries (Kivimaa et al. (2019), community groups and incumbents (Wittmayer et al., 2017; Avelino et al., 2016).

Resilience as an Analytical Lens

Resilience has emerged as a critical lens in ST, particularly for regions like Pacific SIDS, where vulnerability to external shocks is pronounced. Scordato and Gulbrandsen (2024) distinguish between *traditional resilience*, which focuses on "bouncing back" to stability, and *transformative resilience*, which enables adaptive change. Their systematic literature review highlights the relevance of *socio-ecological resilience* in energy systems, emphasising the integration of nature into conceptual and empirical frameworks. However, resilience approaches must also navigate *trade-offs*, such as undesirable resilience that reinforces unsustainable structures, requiring careful consideration of normative outcomes. This lens is pertinent for Pacific SIDS' energy, food and waste systems.

Experimentation and Learning

Experimentation is increasingly recognised as a key mechanism for driving system innovation and fostering social learning under conditions of uncertainty. Sengers et al. (2019) define experiments as inclusive, practice-based, and challenge-led initiatives that link niche development with processes of learning and protection. Grassroots and practice-based experiments are particularly relevant for Pacific SIDS, where community-driven innovations rooted in cultural practices play a pivotal role in navigating sustainability challenges.

Complementing this, *serious games* have emerged as innovative tools for promoting sustainability education and systems thinking. Stanitsas et al. (2019) explore how serious games enhance users' understanding of sustainability issues, categorising these games according to the *triple bottom line* of sustainability (economic, social, environmental). While limitations remain, serious games hold meaningful potential as tools for participatory education and behavioural change, particularly when adapted to reflect local contexts and knowledge systems.

CE as a Systemic Tool

The *CE* provides a complementary framework for achieving ST by decoupling economic growth from resource extraction (Ellen MacArthur Foundation, 2013). Kandpal et al. (2024) reframe CE as a *systemic and multidimensional tool* that operates at micro, meso, and macro levels. CE emphasises closing material loops, optimising resource flows, and promoting regenerative practices, while integrating diverse scientific disciplines such as engineering, economics, and social sciences. However, Kandpal et al. (2024) highlight that deeper *interdisciplinary synergies* are needed to fully realise CE's potential.

For Pacific SIDS, this study argues that CE strategies offer viable pathways to enhance resource efficiency, reduce dependence on imports, and achieve climate resilience. Recent initiatives, such as 3R (Reduce, Reuse, Recycle) programmes, demonstrate the region's commitment to aligning CE principles with the *PA targets* (UNCRD, 2024).

Synthesis of trajectories

This literature review synthesises foundational and emerging scholarship on ST and the CE, positioning the thesis within a broader global discourse. While structural frameworks such as the *MLP* provide theoretical grounding, the integration of *non-technical disruptions, socio-ecological resilience, experimentation, and CE practices* reflects a growing emphasis on systemic, behavioural, and place-based approaches to sustainability. For Pacific SIDS, where cultural and ecological systems are deeply interconnected, these insights underscore the importance of context-specific pathways that balance technical solutions with *relational governance, cultural practices, and transformative resilience*. This is consistent with contemporary ST agendas (e.g., Köhler et al., 2019).

This review provides the foundation for exploring how Pacific SIDS can navigate ST to achieve resilience, equity, and alignment with global climate targets.

1.2.2. Interdisciplinary positioning

The literature review established the foundational frameworks and themes shaping ST and the CE, while identifying critical gaps and opportunities. Building on these insights, this section positions the research within an interdisciplinary framework that integrates economics, ecological systems, anthropology, and international law. It highlights how the study contributes empirically to understanding CE performance in Pacific SIDS and conceptually through the Indigenous Triple Helix (I-TH) model (Chapter 6), addressing the unique challenges of SD in this region.

Interdisciplinary foundations for sustainability transitions

Situated within the Economics faculty, this study began as an inquiry into the *CE* within the context of Pacific SIDS. It became clear early on that the CE operates within the broader

framework of ST (Oliveira et al., 2021). While the CE is often treated as an operational framework focused on micro-level activities (Prieto-Sandoval et al., 2021), outcomes are enabled (or constrained) by macro-level structures and policy regimes (McCarthy et al., 2018). Furthermore, the (Triple Helix) TH innovation lens (Etzkowitz & Leydesdorff, 1998), helps explain how university-government-industry collaboration underpins transformative platforms (e.g., the EU bioeconomy strategy, *Innovating for Sustainable Growth, 2012*), while the I-TH model adapts this logic to Indigenous knowledge, values and governance in Pacific contexts.

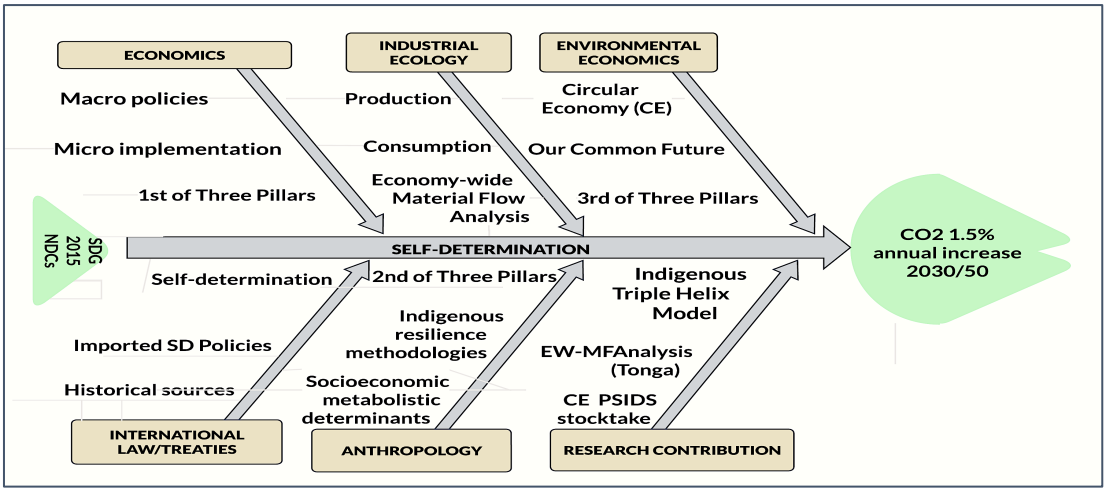
To maintain clarity for this section, the definition of the CE, which is reiterated throughout this thesis, is as follows:

> The circular economy is a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacturing, recycling, and composting. The circular economy tackles climate change and other global challenges, such as biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources. (EMF[3])

Figure 1.2 provides a visual guide to the interdisciplinary positioning of this study.

[3] https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Figure 1.2. Interdisciplinary research parameters



Source: Author

Adopting Ecological Economics

The use of economic models to explain interlocking resource flows, with a focus on ecological concerns, has been a core part of environmental discourse, particularly following the publication of *The Limits to Growth* (Meadows et al., 1972). Venkatachalam (2007) highlights how the neoclassical methodology of environmental economics gives it an edge in policy recognition. However, this research adopts the Ecological Economics position, which lacks the same policy-driven utility but offers a broader, more encompassing framework, accommodating the three pillars of the SDGs: environmental, social, and economic.

Specifically, the research applies EW-MFA as a methodological tool to quantify aspects of socio-economic metabolism, a concept derived from social ecology (Haberl et al., 2016). EW-MFA measures how circular a Pacific SIDS is and reveals the flows of resources and materials within its economy, enabling an analysis of production (imports) and consumption (alternatives to imports) decisions. This approach allows for a more holistic examination of the ST, making it well-suited for addressing the unique challenges faced by Pacific SIDS.

Anthropology and International Law

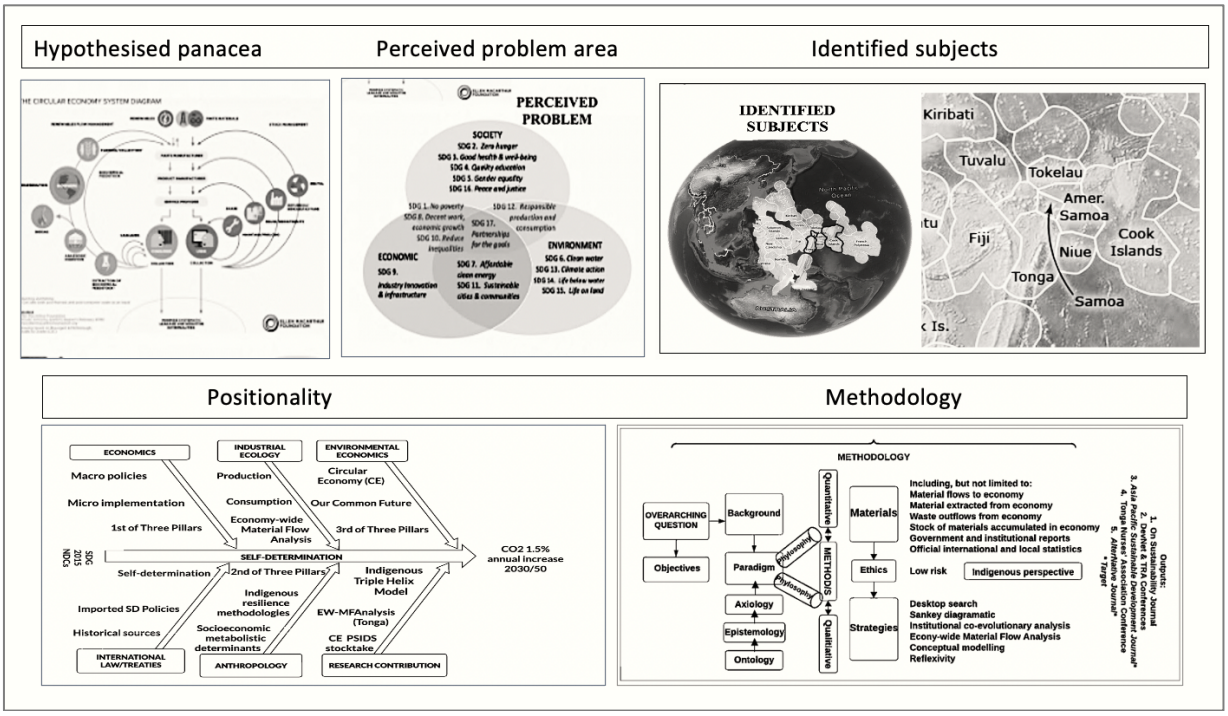
As the research evolved, it naturally extended into fields such as Anthropology and International Law. The research question centres on Indigenous communities within Pacific SIDS, who must reconcile their inherent right to self-determination with the obligations and constraints of treaty-based international agreements such as the SDGs and NDCs. While international law establishes the principle of self-determination, it also imposes frameworks that often prioritise global directives over local agency, creating tensions in implementation. Anthropology provides critical insights into the Indigenous knowledge systems and culturally appropriate solutions that are already embedded in these communities, highlighting their potential to address ST more effectively than externally imposed models. In this context, the I-TH model emerges as a framework to bridge these gaps, adapting the conventional TH to empower Indigenous communities through self-determined, context-sensitive innovation.

1.3. Scope

A comprehensive visual overview of the scope of this thesis is given in Figure 1.3. It provides an overview of the study's key elements, some of which have been introduced in earlier sections, while others will be expanded upon in subsequent chapters. This subsection clarifies the planetary scope of the research, drawing on Boulding's "Spaceship Earth" concept (Boulding, 1966), which frames the selected SIDS not as isolated geographic entities but as integral parts of a broader planetary system. These regions face interconnected environmental limits and challenges shared globally. In addition to the planetary context, this subsection profiles each of the three Pacific SIDS under study, highlighting their unique geographical,

socio-economic, and demographic characteristics that shape their individual approaches to sustainability and development within the global sustainable framework.

Figure 1.3. Research scope impression overview



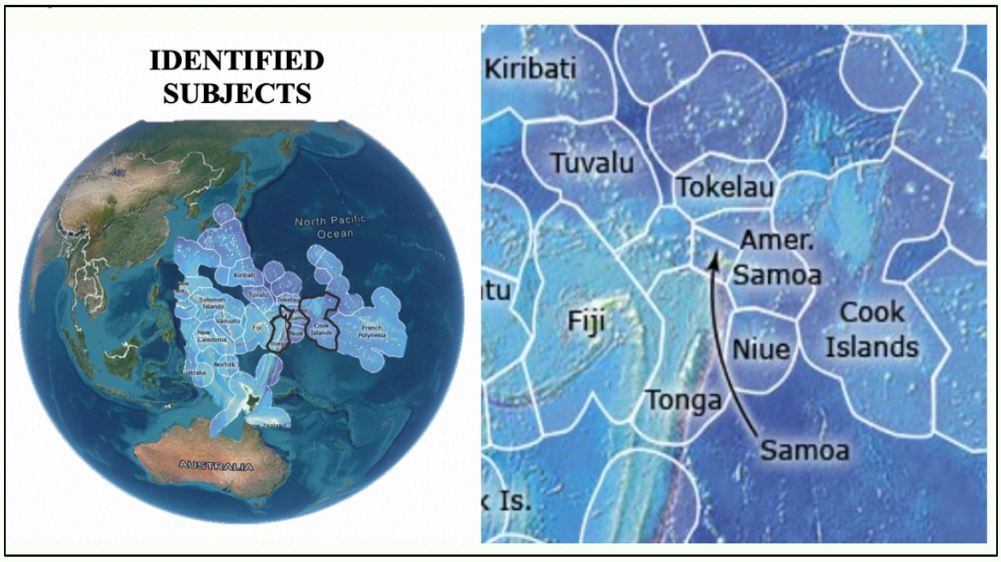
Source: Author

Planetary Perspective

Boulding's (1966) Spaceship Earth concept differentiates the econosphere where natural resources reside, prior to their subsequent transfer through the economic systems, highlighting the interconnectedness of economic and environmental processes. This study also considers the troposphere, which represents the Earth's unified natural systems, further reflecting the planetary interdependence central to sustainability. Contemporary frameworks like Raworth's (2017) Doughnut Economics and Rockström et al. (2009) Planetary Boundaries help contextualise global accountability, particularly in relation to the SDGs and the PA. This planetary context frames the research, aligning with Objective 2 of this thesis, which examines how Pacific SIDS can engage with global sustainability efforts while addressing their unique

challenges. Figure 1.4 highlights the Identified Subjects for the research component of this study, to the right, shown in exclusive economic zones (EEZ). This is superimposed on the global map to the left, providing the geographic and spatial representation that aligns with the scope of the research.

Figure 1.4. Selected SIDS exclusive economic zone relative to global context



Source: Google[4] use permitted. Also NIWA permitted use of TE ARA[5] map.

Pacific SIDS Conceptual Space

In contrast to the Western emphasis on material limits and expansion, the Pacific SIDS worldview is argued to emphasise intangible values inherent in their relationships with nature, self, social context, and, above all, a higher external power. McNamara et al. (2021) capture an aspect of this worldview through their concept of *non-economic loss and damage*, which highlights losses that cannot be measured in monetary terms, such as cultural heritage and spiritual connections. Similarly, Indigenous knowledge systems regard the Pacific Ocean not

[4] https://about.google/brand-resource-center/products-and-services/geo-guidelines/#required-attribution
[5] https://teara.govt.nz/en/map/6964/pacific-island-exclusive-economic-zones

merely as a resource, but as a source of life, wisdom, joy, and identity, transcending material value systems and constraints (Teariki & Leau, 2024; Latu, 2017; Lee, 2014).

This perspective sharply diverges from the Western economic focus on scarcity and progress, favouring instead a spiritual and conceptual expansiveness rooted in *custodianship*. For Pacific SIDS, resources are not owned but entrusted to each generation as a responsibility to preserve and protect. This aligns with Stahel's (2016) explanation of CE as a transitional framework of "ownership giving way to stewardship". The Pacific SIDS's unique worldview reframes "limits," extending them beyond material boundaries to encompass intangible treasures such as knowledge, joy, and resilience in overcoming challenges. To realise their full potential in achieving SD, Pacific SIDS must be granted the freedom to exercise self-determination, ensuring that their cultural and ecological wisdom drives the process. Grounded in these broader values, their Indigenous framework plays a pivotal role in Objective 3, exploring how Pacific SIDS can apply their cultural knowledge within the CE to achieve SDGs without compromising their autonomy.

Research subjects' scope

To account for the full coverage of SDG outcomes, a complete profile pertaining to economic, geographical, and demographic conditions of the three SIDS is necessary and summarised in Table 1.2.

Table 1.2. Geographical subjects' profile

Profile	Samoa	Tonga	Cook Islands
Geographical location	Latitude:13.7590° S Longitude:172.1046°W	Latitude: 21.1790° S Longitude:175.1982° W	Latitude: 21.2367° S Longitude:159.7777° W
Geographical feature	Adjacent to the West of American Samoa and North of Tonga	An archipelago located southeast of Fiji and just to the east of the International Date Line.	Directly to the East of Tonga.
Approximate size	1,125 km²	260 km²	67 km²
Approximate Exclusive Economic Zone size	120,000 km²	700,000 km²	1.8 million km²
Demographics: **Population (latest data)**	205,557 51% male 49% female	100,179 49% male 51% female	14,987 49% male 51% female
Working age population	54% (16-65 years)	65% (≥15years)	58% (15 -59 years)
Economic indicators: **GDP (2022)**	$2,641.3 million USD$996.16 million	$1,086.3 million USD$461,634 million	$448 million USD$273.1
GDP per capita	$12,848. USD$4698.	$11,085. USD$4708	$29,892. USD$18,206.
Main economic activity Percentage of GDP	Tourism 20%	Tourism 48%	Tourism 73%
Remittances as percentage of GDP*	33.6%	43.5%	29.8%
Sources: National Statistics Websites of Samoa, Tonga and Cook Islands Samoa – https://www.sbs.gov.ws/national-accounts/ Tonga - https://tongastats.gov.to/statistics/economics/national-accounts/ Cook Islands - https://stats.gov.ck/census-2021-updates/ *World Bank - https://blogs.worldbank.org/en/peoplemove/remittances-east-asia-and-pacific#:~:text=In%202022%2C%20remittance%20receipts%20measured,Marshall%20Islands%20(figure%202.2).			

Rationale for selecting the three SIDS

The selection of the three Pacific SIDS for this study was strategic, chosen for their geographical proximity, shared ocean space, and resources, which range significantly in size from 237 to 2,840 square kilometres (Pacific Community, Statistics for Development Division, n.d.). Although these islands follow similar historical shipping routes for material imports (Matson Ocean Shipping) and share a common cultural origin in Polynesia (Hudjashov et al., 2018), their divergent historical foreign relations and development pathways provide a unique opportunity to study the complex dynamics of CE adoption and adaptation (Bennion, 1987; Herr, 1975; NZ MFAT, 2021; Tonga Ministry of Foreign Affairs, 2019; Cook Islands Ministry of Foreign Affairs and Trade, 1964; Ministry of Finance Samoa, 2021). Thus, the characteristics of these three SIDS are ideally representative, yet sufficiently distinct, to observe the complex correlations relevant to this study's exploration of CE practices and policies. Reproduced from Chapter 2, p. 40.

1.4. Research methodology

1.4.1. Research Design & Methods Overview

Overarching question

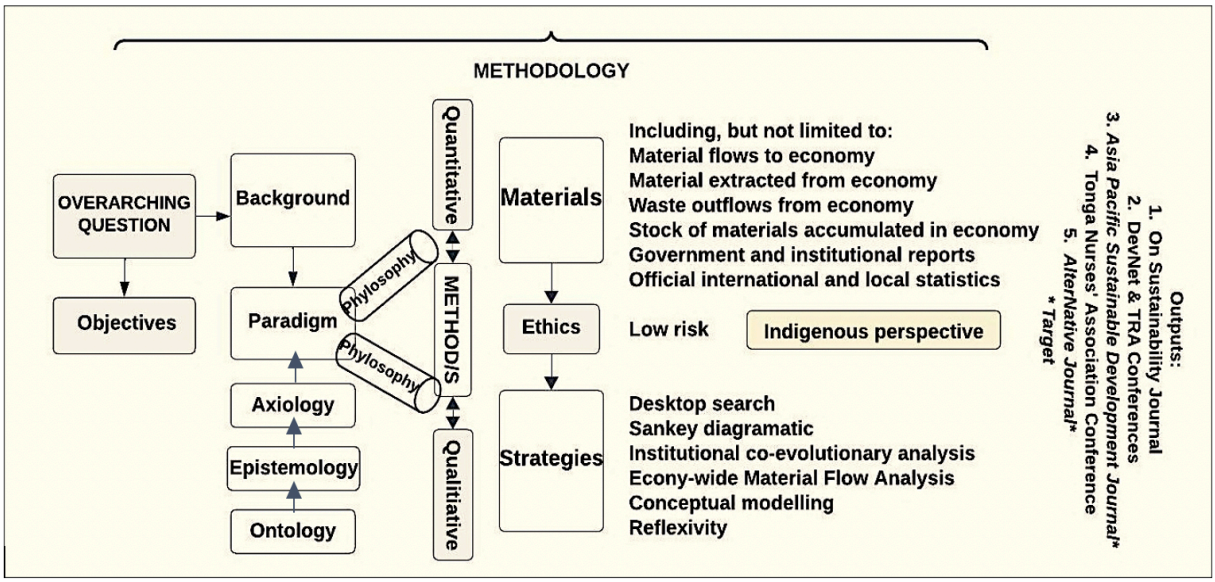
As this thesis is presented with publication, each chapter contains its own detailed methodology appropriate to its research objectives. However, to ensure conceptual coherence across the thesis, this section provides a methodological overview that reflects the overarching philosophical and design logic guiding the research process.

Figure 1.5 below synthesises the relationship between research objectives, epistemological stance, methods, and ethical considerations. It also reflects the influence of Indigenous perspectives and Pacific-specific knowledge systems that shaped the ethical and methodological

choices throughout the study. Rather than duplicating each chapter's content, this section outlines the broader philosophical and strategic orientation of the thesis.

The central question postulates that a CE could contribute to advancing Pacific SIDS SDGs in alignment with the PA target of limiting the average global temperature increase to 1.5°C by 2025 or, at the latest, 2030. For Pacific SIDS, as with all PA signatories, progress is communicated through NDCs, reported every five years. Thus, the overarching research question is formulated as: Can a CE advance Pacific SIDS' SDG and NDC targets while preserving self-determination? Central to this research project is the Indigenous perspective, from which the ontological position will later be established.

Figure 1.5. Methodological considerations



Source: Author

Objectives

Three primary objectives were proposed to address the central research question. The first, *diagnostic* in nature, involved conducting a stocktake of CE practices across three SIDS: Samoa,

Tonga, and the Cook Islands. The second objective sought to *measure* the circularity of these nations through an EW-MFA.

During the exploratory phase of Objective 2, analysis showed that national-level resources, often structured within the "TH" model, an innovation framework based on institutional collaboration between universities, government, and industry and frequently embedded in national policy, were pivotal in similar European Union (EU) projects. For instance, the EW-MFAs for Flanders were undertaken by a CE Policy Research Centre (OVAM, 2021) for governmental purposes. In contrast, this research faced limitations due to a lack of institutional collaboration and resources. As a result, the initial plan to calculate the circularity gap for all three SIDS had to be adjusted, narrowing the focus to one selected nation. Although data eventually became available for conducting an EW-MFA for all three nations, time constraints prevented the inclusion of results for all three countries in this thesis.

The third objective involved developing a conceptual framework tailored to Pacific SIDS, informed by the TH model of innovation that emerges from collaborations among universities, industry, and government.

As the TH model for sustainability has primarily been developed in industrialised nations, its foundational role in guiding SD ideation and directional strategies raised significant concerns regarding its compatibility with the ontological, epistemological, and environmental realities of Pacific SIDS. A framework built on incompatible foundations risks structural failure, rendering it ineffective in addressing the unique challenges faced by Pacific SIDS. This necessitated the formulation of Objective 3, which aimed to investigate how an Indigenous adaptation of the TH model might look and whether it could contribute meaningfully to the SD discourse in Pacific

SIDS. Consequently, the third objective was designed to incorporate an Indigenous perspective into advancing sustainable innovations.

Background

The 17 SDGs encompass a broad spectrum of transformative objectives, necessitating multidisciplinary approaches to tackle complex global challenges. Since the SDGs were enacted in 2015, there has been a marked surge in related academic literature, a trend that continues to grow. Central to this expanding body of work is the prominence of ST research, which increasingly employs mixed-method methodologies and integrates interdisciplinary and transdisciplinary perspectives.

This shift reflects an understanding that sustainable solutions to the intricate challenges at the intersection of society and nature cannot be achieved through single-discipline approaches or even multidisciplinary efforts alone. Instead, they require interdisciplinary integration spanning the natural sciences, social sciences, applied sciences, and humanities (Focht & Abramson, 2009). This integration signals a departure from traditional epistemological stances, which have historically been informed by dominant philosophical paradigms. The urgency of addressing global challenges, compounded by the limited timeframe for achieving SDG targets, has catalysed a paradigm shift in sustainability research.

In this evolving landscape, this research aligns itself within a clearly defined paradigm that underscores the urgency and transformative nature of the global sustainability agenda.

1.4.2. Ontology, Epistemology, Axiology

Ontology

Several subtle clues presented in the preceding sections of this research's methodology point to a relational ontological position alongside a pragmatic methodological orientation. These clues emerge from the global conditions, geographical and cultural contexts, and the objectives tied to specific methods, such as governance coevolutionary analysis and EW-MFA. Furthermore, the consistent emphasis on the Indigenous perspective reinforces the relational ontological position of this research.

While post-pragmatism might appear to be a natural extension of a pragmatic approach, this thesis explicitly avoids aligning with post-pragmatic philosophy. This stance is informed by critiques such as those offered by Howe (1988) and cited in Tashakkori and Teddlie (1998, p. 12), who contend that:

> Much of pragmatic philosophy (e.g., Davidson, 1973; Rorty, 1982; Wittgenstein, 1958) is destructive – an attempt to get philosophers to stop taking concepts such as truth, reality, and conceptual scheme, turning them into super concepts… and generating insoluble pseudo problems in the process.

This distinction is significant, as post-pragmatism tends towards abstract philosophical debates that often detract from practical applications. In contrast, this thesis maintains a focus on pragmatic, context-specific solutions. For instance, the I-TH model developed in this research is firmly rooted in moral and cultural values, aiming to provide a sustainability framework relevant to Pacific SIDS. By adopting a pragmatic methodological orientation, this research prioritises approaches suited to addressing real-world challenges, while its relational ontology grounds the research in the lived experiences and relationships of local communities.

Axiology

The axiological foundation of this research is rooted in Indigenous moral principles. As Tuhiwai-Smith (1999) emphasises, Indigenous research must operate within an ethical framework that prioritises community well-being and honours Indigenous knowledge systems. Central to this study is the I-TH, developed within this research, which reflects the interconnected relationships between God, People/Land, and Heritage. This model is grounded in Pacific SIDS moral values and provides a culturally relevant framework for sustainability, underpinned by the fundamental right to self-determination.

This research aligns with the perspectives of Indigenous scholars and practitioners such as Havea et al. (2021), Smith (1999), Thaman (2019b), Palaamo (2018), Ka‘ili (2008, 2017), Tuinukuafe et al. (2012), Nabobo-Baba (2006) and Sanga (2004), who stress the importance of Indigenous worldviews and the realities from which they emerge. It is firmly situated within the axiological and ontological dimensions of the local Indigenous context. Specifically, when research aspires to achieve socioeconomic transformation, the ethical and moral implications of that transformation must rest entirely with the communities it affects. Failure to uphold this responsibility risks reducing ST to bureaucratic processes at best or, at worst, inhumane objectives that disregard the values and lived experiences of local populations.

Epistemology

This research adopts a pragmatic epistemological stance, prioritising actionable and context-specific knowledge that bridges Indigenous and Western paradigms. Indigenous knowledge systems are relational and holistic, emphasising interconnectedness between people, land, and culture, as reflected in the I-TH model.

In line with this epistemology, the research employs mixed methods to capture both quantitative insights (e.g., EW-MFA) and qualitative dimensions (e.g., governance coevolutionary analysis). This approach reflects a commitment to integrating multiple ways of knowing, ensuring that the research remains grounded in both cultural relevance and practical applicability. By doing so, the research aligns its epistemological foundation with its broader goal of contributing to SD in Pacific SIDS.

Conclusion

By approaching the methodology from this deeper perspective, the thesis presents a cohesive research narrative grounded in core philosophical, ontological, axiological, and epistemological principles. These elements act as subtle yet influential drivers throughout the research process, informing the choice of methods, data interpretation, and the presentation of findings across each publication. Although each paper offers a complete and independent methodological account, the thesis is unified by these foundational principles.

A mixed-methods approach, grounded in a pragmatic paradigm, supports the study's ability to address complex research questions by integrating quantitative and qualitative insights. Reflexivity, maintaining an awareness of the researcher's role in shaping the research, also plays a crucial part in ensuring the research remains philosophically and ethically aligned across all outputs. The epistemological stance, emphasising actionable and culturally grounded knowledge, further solidifies the coherence of the methodology in addressing the unique challenges of Pacific SIDS.

1.4.3. Reflexivity & Methodological Evolution

Introduction

Olmos-Vega et al. (2022, p. 241) argue that qualitative researchers should capitalise on reflexivity throughout their research process, incorporating it into multiple dimensions and presenting it throughout the entire manuscript. They define reflexivity as: "…a set of continuous, collaborative, and multifaceted practices in which researchers critically reflect on how their subjectivity and context influence the research process…", (Olmos-Vega et al. (2022, p. 242). Similarly, Ide and Beddoe (2023) recognise reflexivity as crucial and pivotal in qualitative research methodology, but note that it is often difficult to define clearly and can be challenging for researchers to practise consistently. Reflexivity is particularly applicable in consideration of the study of behaviours and practices in socio-technical systems and sustainability. It involves critical self-awareness of the researcher's role, potential biases, and how background, experiences, and perspectives influence the research process and outcomes.

Methodological Decisions: Reflexivity in Refining Objectives 1 and 2

Reflexivity was integral in refining Objectives 1 and 2, shaping both the choice of methods and their alignment with the broader goals of the research. For Objective 1, the governance coevolutionary analysis was adopted as a high-risk but ultimately rewarding methodological choice. Its application provided the analytical depth and permeation needed to examine the complex characteristics of the MLP within a SD context. This rich, systems-oriented approach enabled a dynamic understanding of governance through the coevolution of material-economic conditions, institutional actors, and discursive practices, surpassing the limitations of more linear analytical methods and extending the methodological reach of the study.

For Objective 2, the EW-MFA was similarly proposed by the supervisory panel as a method that appeared initially beyond the researcher's capability. Reflexive consideration of the research context, particularly the pressing material flow challenges in Pacific SIDS, dictated the need to pursue this method despite its perceived complexity. Observations in the Cook Islands - such as overflowing landfills due to container shipments and excessive material inflows, underscored the relevance of the EW-MFA for addressing the environmental impacts of material flows. By embracing this quantitative methodology, the researcher achieved similarly satisfactory outcomes, effectively addressing the thesis's goals. Reflexivity ensured that the EW-MFA was adapted to align with the research context and theoretical framework, complementing the qualitative methods used elsewhere in the thesis and contributing to an interdisciplinary understanding of CE practices.

Personal to directional influence

As the research progressed, the distinct roles of the three objectives became increasingly apparent: Objective 1 served a diagnostic purpose, Objective 2 focused on measurement, and Objective 3 provided for a conceptual objective to propose an Indigenous framework for sustainability. The progression from empirical diagnosis to conceptual development unfolded naturally through the study's engagement with Pacific values, which, as confirmed in Objective 1, were central to the success of circular strategies, and led to a growing recognition of the need for an Indigenous approach. This evolution culminated in the formulation of the *I-TH model*, a culturally grounded adaptation of the conventional innovation model, which articulates the interconnected relationships between God, People/Land, and Heritage. Grounded in Tongan worldviews, the model offers a culturally resonant framework to advance sustainability in Pacific SIDS and constitutes the core contribution of Objective 3.

Parallel to this development, the researcher was actively engaged in two community projects, with a third planned midway through the research. These projects provided practical insights into decision-making processes, project dynamics, and outcomes, offering a unique perspective on the mobilisation of social capital within Tongan communities. In 2023, a site visit to Tonga, sponsored by the lead supervisor - a specialist in social capital, coincided with the culmination of these projects. This alignment presented an opportunity to observe and analyse relational dynamics and collective efforts in real time, enriching the research with practical and culturally embedded insights.

While the original plan for Objective 3 centred on a conceptual paper, a complementary opportunity arose to undertake a social capital study during the supervisor-led site visit to Tonga. Although ethics constraints required the exclusion of identifiable individual-level data, the remainder of the social capital paper, grounded in culturally ethical research practice, was included in the thesis. This inclusion became particularly significant when preparing for the International Tongan Nurses' Association Conference, where the convergence of social capital, EW-MFA (Objective 2), and SDG 3 (health and well-being) was brought into focus. As with the "Matters Arising" chapters based on Objectives 1 and 2, which each produced conference papers but remained unpublished, the social capital content integrates meaningfully into the overall thesis and enhances the development of Objective 3.

This reflexive evolution of Objective 3 underscores the dynamic nature of the research process. It demonstrates how emerging opportunities, combined with cultural and ethical considerations, shaped scholarly direction while maintaining the integrity and relevance of the research outcomes.

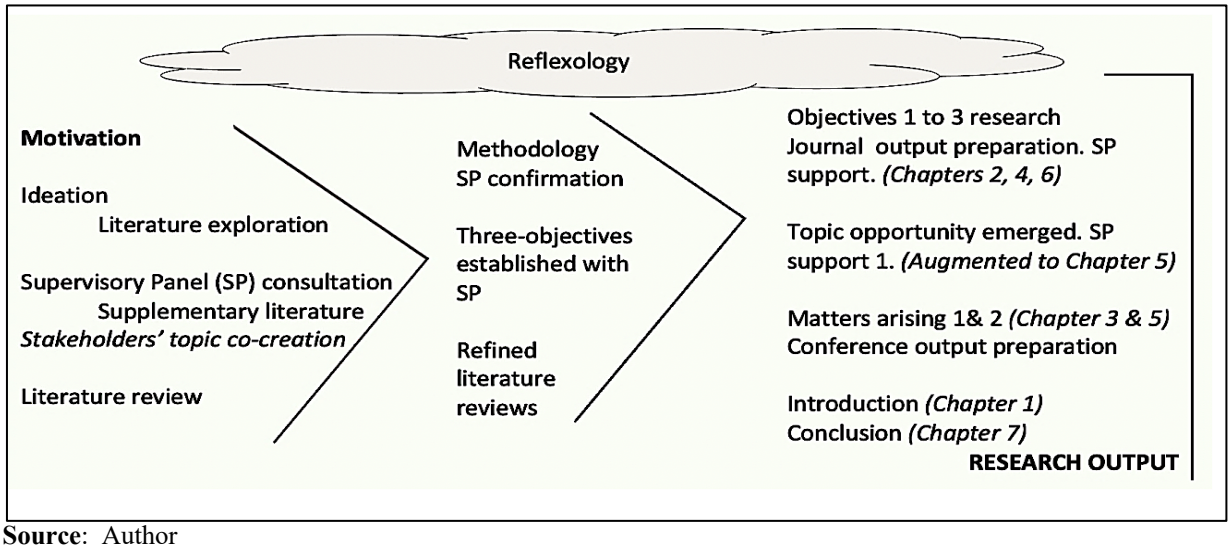
1.4.4. Research Outputs and Integration

As the research progressed, the conceptual, methodological, and reflexive elements began to converge into tangible outputs. This phase involved preparing journal articles, conference papers, and developing additional contributions arising from unexpected opportunities. It also provided a point of synthesis where the original objectives, grounded in supervisory engagement and stakeholder relevance, were shaped into a coherent thesis structure. The following paragraphs trace this integration process, leading into the final layout of research contributions.

Prior to finalising the decision to defer the full publication of the social capital paper, an opportunity arose to present at the International Tongan Nurses' Association Conference, under the theme *"Working Harmoniously."* A conference paper was drafted to align with this theme, integrating concepts from *Objective 2 (Chapter 4),* including social metabolism, with social capital and SDG 3, which focuses on health and well-being within the Ministry of Health context. The paper examined the nested relationships among these three concepts, demonstrating how they can work harmoniously together to inform ST in Pacific SIDS.

By this stage of the research, the structure and content of all papers were known to the researcher. Figure 1.6 provides an overview of the research output cognitive process. *Objectives 1 to 3* represent the core contributions of the three primary papers: Paper 1 (Chapter 2), Paper 2 (Chapter 4), and Paper 3 (Chapter 6). *Topic opportunity emerged* is augmented to Chapter 5, with Matters arising 1 (Chapter 3) and Matters arising 2 (Chapter 5). The author's reflexive approach is inherent throughout the doctoral research process.

Figure 1.6. Research output cognitive process



Source: Author

Conclusion

Reflexivity in this research underscores the importance of ethical and methodological flexibility, particularly within Indigenous ethical frameworks where knowledge-sharing is relational and built on trust and reciprocity. This process has been instrumental in navigating the complexities of culturally embedded research, ensuring that methodological choices were both philosophically grounded and practically viable.

A pivotal moment in this reflexive journey arose with the decision to defer the publication of the social capital paper. This decision reflected a commitment to rigorous ethical standards and the ongoing responsibilities of stewardship and cultural integrity. It also highlighted the dynamic nature of reflexive practice, where ethical and cultural considerations shape scholarly direction. By navigating these challenges, the research has remained respectful of Indigenous ethics while contributing meaningful insights to sustainability and social capital in Pacific SIDS.

This journey has illuminated the transformative power of reflexivity in balancing the dual roles of researcher and cultural insider. It has fostered both scholarly rigor and personal growth,

providing valuable lessons in maintaining academic integrity while honouring cultural contexts. These insights will continue to inform future scholarly endeavours, ensuring that they remain both culturally grounded and academically impactful.

1.5. Ethics approval

At the outset of this research, a Massey University Low Risk Notification was completed for the initial scoping and stakeholder-discussion stage, in accordance with established University guidelines and the Massey University Code of Responsible Research Conduct (2018 ed.). The process classified the initial activity as low risk and did not constitute full Human Ethics Committee approval.

Throughout the research, ethical principles such as voluntary participation, confidentiality, and respect for participants' rights were rigorously upheld. These principles were particularly emphasised during the topic co-creation process, where all parties were fully informed and engaged, ensuring their consent and active participation. This commitment to ethical integrity not only safeguarded the rights and well-being of participants but also reinforced the research's alignment with culturally appropriate practices and standards.

Separately, in accordance with Tonga's research protocols, a full ethics application was also completed to secure approval for conducting research in Tonga. This additional application ensured compliance with Tonga's national standards and reinforced the research's cultural and ethical alignment.

1.6. Organisation of the Thesis

This thesis investigates whether the CE can advance SDGs and NDCs in Pacific SIDS while maintaining self-determination. Anchored in a mixed-methods approach, the research is organised around three primary objectives. These objectives include: a stocktake of CE progress and strategies in Pacific SIDS (Objective 1); an EW-MFA to assess circularity in a remote Pacific SIDS (Objective 2); and the development of an Indigenous framework for ST, grounded in resilience and self-determination (Objective 3). Collectively, the studies contribute to advancing the discourse on Indigenous sustainability and governance in the Pacific. This thesis contains seven chapters, organised as follows:

Chapter 1 establishes the foundation for the research, providing the contextual, methodological, and ethical frameworks that guide the study. It begins by contextualising the problem and positioning the study within its systems and interdisciplinary focus. The chapter outlines the spatial, conceptual, and geographical coverage of the thesis, followed by profiles of the Pacific SIDS represented in the study. The methodology overview highlights the mixed-methods approach, supported by dedicated subsections on reflexivity and ethics that emphasise transparency, integrity, and cultural sensitivity.

Chapter 2 presents the first full paper prepared for publication and addresses Objective 1 of the study. It undertakes a systematic stocktake of CE activities and strategies in three Pacific SIDS. This chapter employs an institutional coevolutionary analysis to examine how CE practices emerge, adapt, and interact with institutional dynamics in these contexts. It begins by defining CE concepts relevant to the study's focus and outlines the conceptual framework for identifying and categorising CE initiatives. The research materials and methodological approach are then detailed, followed by the presentation of findings that reveal both progress and persistent gaps

in CE implementation. The chapter concludes with a discussion of key insights, limitations, and implications for future research. A brief epilogue provides a thematic bridge to Chapter 3.

Chapter 3 focuses on the first "Matters Arising" theme derived from Objective 1, exploring whether SDG policies in Pacific SIDS enable or undermine Indigenous self-determination. Originally written as a conference paper, the chapter builds on insights from Chapter 2 by redirecting the focus on CE to critically engage with the three-pillar model of SD, proposing an Indigenous alternative grounded in Tongan philosophical imperatives. It begins with a prelude and introduction, followed by an abstract and a review of relevant literature. The chapter then explores Tongan imperatives as alternative philosophical pillars of self-determination, illustrated through a culturally grounded historical case study. This case study analyses specific events and decisions that demonstrate how these Indigenous principles are enacted in practice. The chapter concludes with a reflective discussion that situates the findings within a culturally embedded framework. A brief epilogue then transitions the reader to Chapter 4.

Chapter 4 addresses Objective 2 and presents the second full paper, prepared for submission to a peer-reviewed journal. This chapter applies EW-MFA to quantitatively assess the circularity rate and material use within a SIDS. It opens with an introduction that frames the study's aims and contributions, followed by a review of relevant literature and an overview of the island's socioeconomic and environmental context. The chapter then details the methodological approach, presents the results, and offers a critical discussion on the challenges and opportunities for enhancing circularity in resource-constrained island systems. These insights contribute to the empirical and methodological advancement of CE research in Pacific contexts. An epilogue transitions the reader to Chapter 5.

Chapter 5 addresses the second "Matters Arising" theme linked to Objective 2. Due to its dual focus, the chapter departs slightly from the format of earlier chapters and is structured around two thematically connected case studies. The first case study introduces a conceptual Matryoshka doll analogy to examine the policy-interface relationship between SDG 3, social capital, and socioeconomic metabolism. The second builds on this analysis through a more focused examination of social capital, offering additional empirical depth to the chapter's central themes. In line with the other case studies presented in the thesis, both contribute to enriching the Indigenous analytical foundations that ultimately inform the development of the Indigenous triple helix framework introduced in the final chapter. Each is presented with its own internal structure, and the chapter concludes with an epilogue that transitions to Chapter 6.

Chapter 6 presents the third and final primary paper and addresses Objective 3. Titled *Indigenous Resilience and Self-Determination for ST: A Pacific SIDS Model*, this chapter introduces the I-TH model as a conceptual framework for advancing resilience and self-determination in Pacific SIDS. Juxtaposed with the traditional TH model of innovation, the I-TH offers a culturally grounded alternative that positions Indigenous knowledge and relationships as drivers of CE innovation aligned with Indigenous worldviews. The chapter culminates in a discussion of the model's implications for ST in island contexts and concludes with an epilogue that transitions to the final chapter.

Chapter 7 consolidates the thesis's core insights, drawing together its conceptual, empirical, and cultural contributions**.** It discusses the implications of the research for advancing circular economy (CE) approaches in Pacific SIDS while upholding Indigenous self-determination, and outlines directions for future research. The chapter also reflects on study limitations and concludes with a reflexive account of the researcher's positionality, challenges encountered, and

insights gained throughout the doctoral journey. This final reflection emphasises the importance of balancing cultural embeddedness with academic rigour and highlights how these lessons will inform future scholarship.

CHAPTER 2

Circular Economy Stocktake in Three SIDS

Foreword

This chapter presents the first of three primary papers that form the core research contributions of this thesis, answering Objective 1. It is reproduced here with the permission of On Sustainability Journal[6]. The study undertakes a stocktake of CE strategies in Samoa, Tonga, and the Cook Islands, utilising the Ellen MacArthur Foundation's Circular Economy Systems Diagram Framework (CESDF). After identifying and analysing the CE strategies of each of the selected Pacific SIDS, the findings and associated policy data are examined through a governance coevolutionary dimensional lens.

While Chapter 1 introduced the conceptual framework, defined the research scope, and outlined the methodological and ethical foundations of the study, Chapter 2 presents the first full research article. A structure for this chapter is provided on page 40.

The significance of this chapter lies in its original empirical contribution to sustainability transition literature from a Pacific SIDS perspective. In the absence of regionally grounded research, sustainability policies in the Pacific have often been shaped by European and Western technical assistance. These external models, while politically appealing, can produce costly and unintended outcomes. This study seeks to address that gap by offering a more contextually

[6] By Common Ground Research Network. https://cgscholar.com/bookstore/works/a-stocktake-of-circular-economy-progress-and-strategy-in-the-pacific-sids?category_id=cgrn&path=cgrn%2F289%2F292

grounded analysis of CE strategies, attuned to the environmental, cultural, and economic specificities of Pacific SIDS.

Abstract

The Circular Economy (CE) concept is integral to sustainable development, yet its theoretical richness contrasts with varied practical applications, as evidenced by over two hundred definitions. This study contributes to understanding this disconnect by analysing CE adoption in three SIDS, examining the interplay between institutional dynamics and sustainable transition policies within Nationally Determined Contributions (NDCs). Utilising the Ellen MacArthur Foundation's butterfly diagram to map CE activities, the study combines mixed methods with institutional coevolutionary analysis to evaluate how CE initiatives align (or fail to align) with national sustainability goals, particularly the NDCs. Results indicate that disjointed CE efforts impact the advancement of NDCs. Local "actor institutions," particularly in Samoa and the Cook Islands, are pivotal, successfully driving projects such as community biogas and solar energy programmes. Conversely, Tonga's centralised initiatives underscore the limitations of top-down approaches. This study underlines the importance of aligning CE policies with local institutional realities to enhance their efficacy and contribute to global sustainability goals.

Keywords: Circularity, Sustainability Transition, Circular Economy, Developing Nations, Policy Commitment, Institutional Coevolutionary Dimensions, Equitable and Just Policies, Remote SIDS.

2.1. Introduction.

In the pursuit of sustainable development (SD) envisioned in the Brundtland Report (1987), the circular economy (CE) has emerged as a prominent framework for integrating economic activity and environmental well-being (Halog & Anieke, 2021). However, its theoretical richness has produced a wide diversity of interpretations, over 200 definitions, resulting in fragmented implementation and contested meaning (Kirchherr et al., 2017; Geissdoerfer et al., 2017; Calisto Friant et al., 2020; Corvellec et al., 2022). While early adopters such as Germany and China laid the foundation in the 1990s (Winans et al., 2017; McDowall et al., 2017), CE has since proliferated across geographical contexts and sectors, often lacking social dimensions such as human rights or community wellbeing (Mies & Gold, 2021; Velenturf & Purnell, 2021), which are essential to sustainability in practice.

Influential reports such as the Ellen MacArthur Foundation (EMF) "Towards the Circular Economy" (EMF 2013, 2015) served to attract scholars, policymakers, and practitioners alike, resulting in an exponential increase in academic CE literature in subsequent years. Academic literature grew by 760 percent between 2015 and 2018, following the introduction of the CE package in the EU in 2015 (Schöggl et al., 2020). The World Economic Forum (WEF, n.d.) has set out initiatives on its Platform for Accelerating Circular Economy (PACE). Likewise, the New Zealand Ministry of Foreign Affairs and Trade (NZ MFAT, 2021), Four Year Plan for the Pacific region includes in its Enduring Principles for Pacific nations, a "Journey towards a circular economy" (NZ MFAT 2021, 3) Taken together, these developments suggest the emergence of CE as a widely accepted model for reorganising production and consumption towards sustainability targets.

Recent research underscores the potential injustices emerging from the application of CE practices under diverse spatial, environmental, and economic conditions. Bertolino et al. (2023) utilised a sociotechnical multilevel perspective (MLP) study to uncover injustices in biogas development within the contrasting contexts of Brazil and Italy, illustrating disparities across various dimensions in both countries. Lopolito et al. (2022) emphasised the critical role of proximity in sustainability transitions, differentiating between absolute (geographical) and relative (cognitive, organisational, social, and institutional) proximities. They argue that while geographical proximity is important, relative proximity, encompassing trust and respect among actors, is crucial for sustainability. However, they caution that excessive relative proximity may hinder innovation by narrowing the focus of the environmental justice (EJ) network actors. Falcone et al. (2020) demonstrated how EJ movements can effectively drive circular economic transitions. Furthermore, existing models and methods for CE implementation and identification of circularity opportunities (D'Adamo et al., 2021; Falcone, 2019, 2023; Magazzino & Falcone, 2022) remain concentrated in resource-rich and relatively highly populated countries, negating the unique conditions of remote SIDS.

This study positions itself within this evolving discourse, intending to enrich the conceptualisation of CE by integrating the often-neglected aspects within the distinct socioeconomic and environmental contexts of remote Pacific SIDS. The aim of this study is to establish a CE baseline in Samoa, Tonga, and the Cook Islands, drawing on the EMF Butterfly diagram as a systemic framework for identifying CE activities. Subsequently, this study examines the empirical and institutional coevolutionary aspects of the remote Pacific SIDS to investigate the efficacy of sustainable policies that resonate within specific environmental, cultural, and economic contexts. Despite contributing the least to climate change (Thomas et al. 2020; Betzold 2010), the Pacific remains underexplored in the CE literature.

The selection of the three Pacific SIDS for this study was strategic, chosen for their geographical proximity, shared ocean space, and resources, which range significantly in size from 237 to 2,840 square kilometres (Pacific Community Statistics by Country). Although these islands follow similar historical shipping routes for material imports (Matson Ocean Shipping, Truck, Rail and Logistics, n.d.) and share a common cultural origin in Polynesia (Hudjashov et al. 2018), their divergent historical foreign relations and development pathways (Bennion 1987; Herr 1975; Cook Islands Ministry of Foreign Affairs and Trade 1964; Ministry of Finance Samoa, 2021; NZ MFAT 2001; Tonga Ministry of Foreign Affairs, n.d.) provide a unique opportunity to study the complex dynamics of CE adoption and adaptation. Thus, the characteristics of these three SIDS are ideally representative yet sufficiently distinct to observe the complex correlations relevant to this study's exploration of CE practices and policies.

The remainder of this article is organised as follows: The next section introduces CE definitions specific to this research and establishes the conceptual framework for identifying CE strategies and practices. Following this, the research materials and methods are described. The three subsequent sections present the findings, the institutional coevolutionary analysis of the findings, and the conclusion. The article closes with the limitations of the study and suggests directions for future research.

2.2. Defining Circular Economy

The CE is a regenerative economic system that necessitates a paradigm shift to replace the "end of life" concept by reducing, alternatively reusing, recycling, and recovering materials throughout the supply chain. The aim is to promote value maintenance and SD, creating environmental quality, economic development, and social equity, to the benefit of current and

future generations. It is enabled by an alliance of stakeholders (industry, consumers, policymakers, and academia) as their technological innovations and capabilities. (Kirchherr et al. 2023, p. 4)

Attempts to define CE are described as “sensu stricto”(narrow) and “sensu latu” (broad) definitions (Moraga et al., 2019, p. 453). Sensu stricto was defined by Bocken et al. (2016), in which CE is distinguished from linear economy (LE) based on slowing and closing resource loops. “Slowing happens through the design of long-life goods and product-life extension” and closing is when the loop between post-use and production is closed through secondary use of products instead of going directly to waste (Bocken et al., 2016, p. 309; Prieto-Sandoval et al., 2018, p. 613; Reike et al., 2018, p. 250). Conversely, the “sensu latu” definition is all-inclusive, where “planning, resourcing, procurement, production, and processing are designed and managed as both process and output to maximise eco-system functioning and human wellbeing” (Murray et al., 2017). They acknowledged various interpretations of the CE but agreed that it fundamentally represents a cyclical, closed-loop system. Other contributors to the broader definition of CE were Kirchherr et al. (2017), who identified 114 distinct definitions of CE. From this broad scope, they constructed their own, ensuring the inclusion of aspects negated in existing definitions. Korhonen et al. (2018) defined CE as a scientific concept that explicitly links circularity with the environmental dimensions of sustainable development:

> Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow… Successful circular economy contributes to all the three dimensions of SD. A circular economy limits the throughput flow to a level that nature tolerates and utilizes in economic cycles by respecting their natural reproduction rates. (Korhonen et al., 2018, p. 39)

This emphasis on ecological limits also aligns with the planetary boundaries framework of Rockström et al. (2009), which defines a safe operating space for humanity. Subsequent work has extended this framing to consider both safe and just Earth system boundaries (Rockström et al., 2023).

In this study, CE is defined based on three fundamental principles of the EMF: (a) waste and pollution are designed out at the product planning level, (b) products and materials are kept in use at their highest value, and (c) nature is regenerated. These principles are crucial for the SIDS to transition towards SD, underpinned by a shift to renewable energy and materials.

Elaborating on the first principle, waste and pollution are eliminated pre-emptively through strategic product planning. This necessitates Pacific SIDS, as importing nations, to critically assess the products and materials entering their ports and identify sustainable local substitutes that safeguard the health and well-being of their communities and ecosystems.

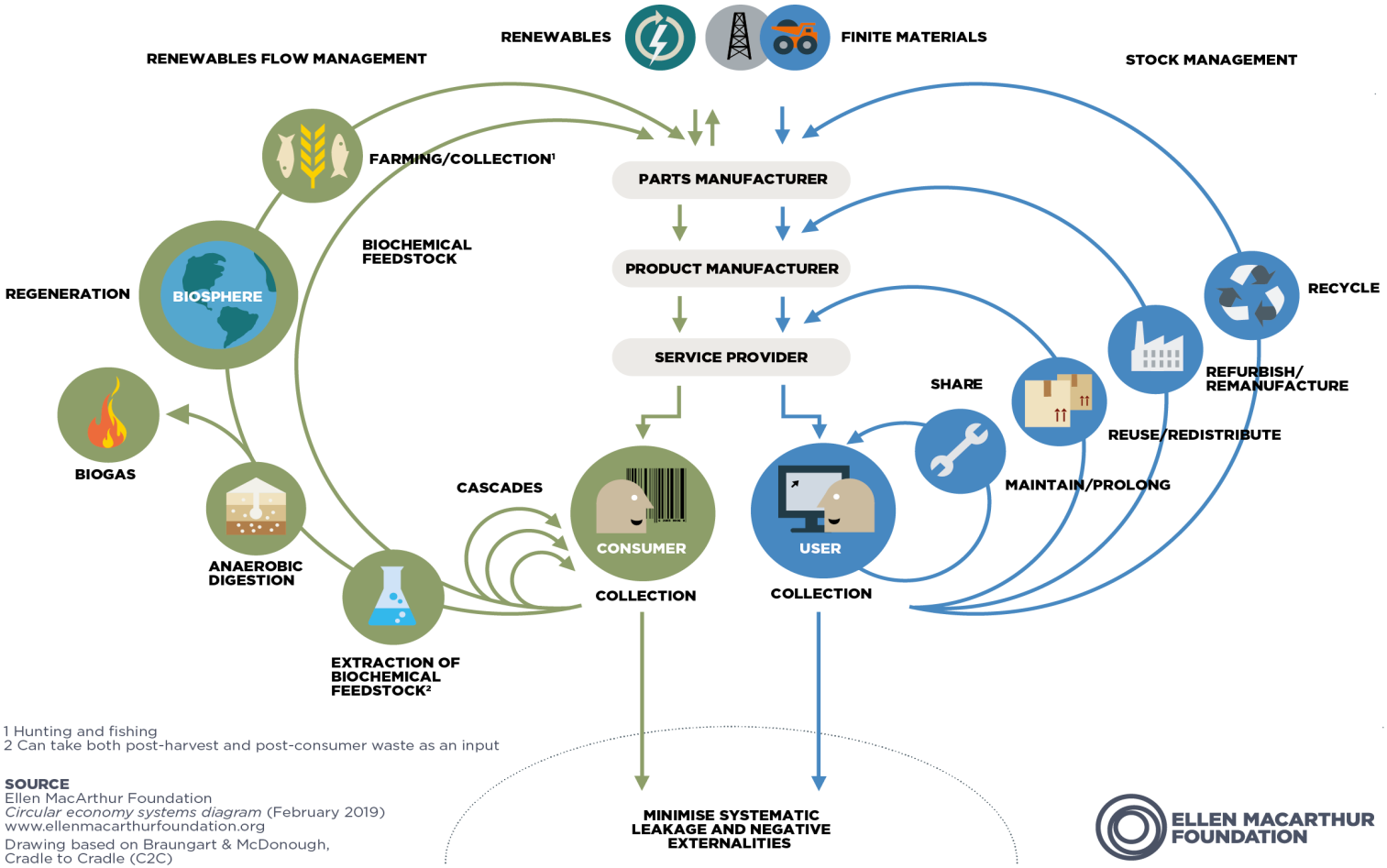
The second principle emphasises the continuous circulation of products and materials with the highest utility. This can be viewed as the demand side of the CE, accompanying the supply-oriented approach of the first principle. A deep understanding of the determinants and drivers of aggregate demand in Pacific SIDS, coupled with the transformative potential of CE, enables a targeted strategy to fulfil environmental goals.

Finally, the third principle, which resonates with the intrinsic values of Pacific SIDS, advocates for the restoration and enhancement of natural systems. This principle is embodied in the harmonious coexistence of people and nature, a concept deeply ingrained in the region's cultural

ethos (Anae, 2019; Bryan-Tokelau, 2018; Haden, 2009; Pulotu-Endemann, 2007; Tamasese & Parsons, 2023). Mitigating the environmental impacts, such as reducing the transportation of unnecessary materials and managing waste more effectively, supports the regeneration of nature, as outlined in this principle. Therefore, consistent with the EMF Butterfly diagram (Figure 2.1), CE is hereby defined as a closed-loop economy in which waste minimisation is designed into a system in which there is a continuous flow of materials, decided by society, in distinct technical and biological cycles within environmental limits.

Collectively, the three principles of the EMF framework form a coherent basis for defining CE in the context of Pacific SIDS. By designing out waste at the border and production stages, keeping materials in circulation with cultural and economic insight, and restoring natural systems rooted in Indigenous values of harmony with nature, the CE offers more than a technical model — it becomes a culturally attuned pathway for sustainable transition (ST). This integrated understanding underpins the study's definition of CE and guides its subsequent analysis.

Figure 2.1. EMF Butterfly diagram



Source: EMF Circular Economy System Diagram[7]

[7] Use authorisation: Clause 6.2.1 of the Ellen MacArthur Foundation's Intellectual Property Rights Policy. For details, see Ellen MacArthur Foundation Policies.

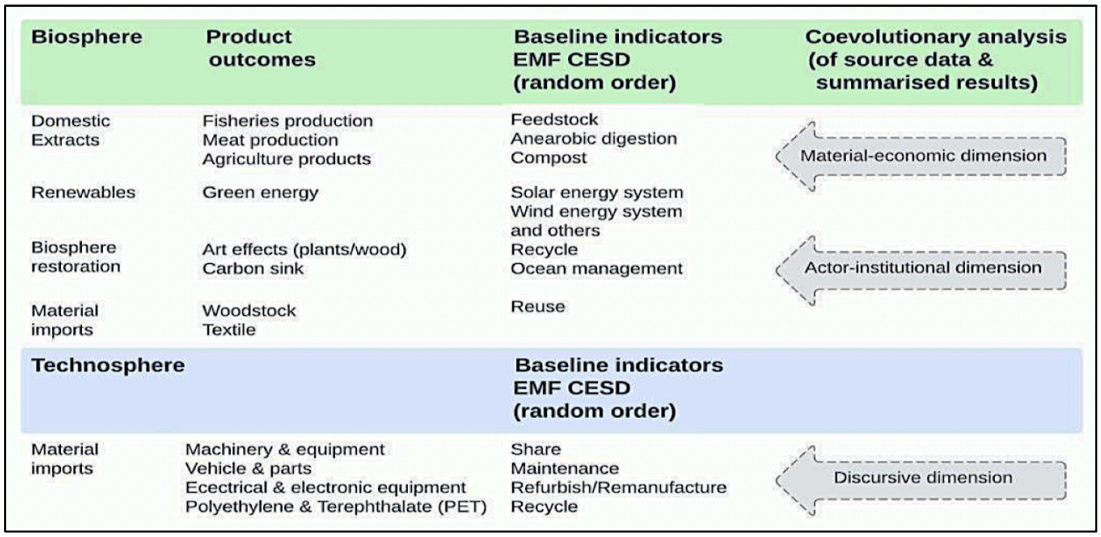
2.2.1. CE baseline indicators and analytical framework for Pacific SIDS

This study derives its baseline indicators for CE in Pacific SIDS from the Ellen MacArthur Foundation's Circular Economy System Diagram (CESD), which builds on McDonough and Braungart's (2002) philosophy. This concept suggests that, like in nature, human-designed systems should favour diversity, cyclical flows, and regeneration.

In designing and using technology, natural elements should be employed where "waste for one is food for another." Under this model, all human-made products should either biodegrade safely as biological nutrients or be continuously reused as inputs in new production cycles. The EMF reflects this concept in the CESD (Figure 2.1), with the aim of prolonging the use of products and minimising the extraction of non-renewable natural resources.

The CESD distinguishes between two key domains: biological production (the Biosphere), and technological production (the Technosphere). Biological materials can safely re-enter natural systems, while technological materials are kept in circulation through reuse, remanufacturing, or recycling (Danilov-Danil'yan & Reyf, 2018; Picot & Guillaume, 2023). Cutting across all technical cycles is the energy used in production, although this is not explicitly shown. Figure 2.2 summarises the baseline CE activities observed in the case study countries, organised to reflect the CESD's biosphere-technosphere distinction and the flow of materials across production, use, and reuse. In addition to these material-related loops, the baseline also recognises complementary restorative and mitigating activities, such as tree planting and ocean management regimes, that operate alongside, rather than within, the material cycles to regenerate natural systems and mitigate environmental impacts.

Figure 2.2. Coevolutionary analytical framework for 3 Pacific SIDS



Source: Author's conception, Pacific SIDS CE baselines and analytical framework

The framework in Figure 2.2 is structured in three columns. The first characterises the material sources and/or flows within the Biosphere and Technosphere. The second expands on these concepts, outlining the resulting product outcomes. In the third, the flows from column two are classified into their CE activity processes and destinations, as depicted in the EMF diagram. Together, these columns trace the path of materials from origin to reuse, capturing the logic of a circular system, while also recognising the restorative and mitigating aspects. Using the same data set, a governance coevolutionary analysis was conducted, revealing how policies, laws, and plans influence the course of these flows within society. Van Assche et al. (2014, p. 81) successfully captured the essence of this dynamic by positing that governance decisions are intimately connected to an understanding of temporal contexts: "from policies, laws, and plans…These decisions incorporate an understanding of the future, of present and past, upon which…the possibility to steer society by means of these decisions is based."

The key concepts and approaches used in this study are the circular economy, the EMF Circular Economy System Diagram, and institutional coevolutionary analysis, applied within a mixed-

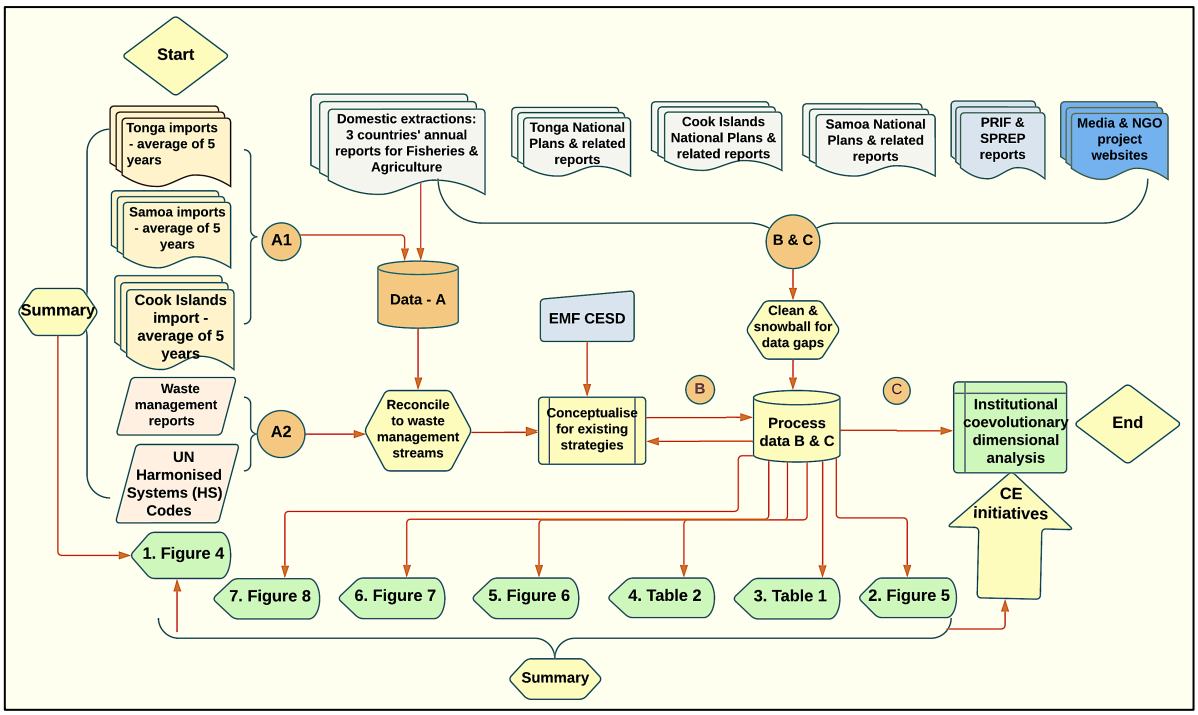
methods design. The CE provides the overarching framework for identifying activities that retain materials in use and regenerate natural systems, while the EMF diagram provides a practical means of classifying these activities across biological and technical cycles. Institutional coevolutionary analysis complements this material perspective by examining how material-economic conditions, institutional actors, and discourse interact to shape CE outcomes. This combination is appropriate for Pacific SIDS because it enables material practices to be considered alongside the institutional and contextual conditions that influence their implementation.

2.3. Materials and Methods

This study adopts a mixed-methods design (Creswell, 2009; Creswell & Sinley, 2017) integrating quantitative data on material inputs with qualitative insights from policy and institutional reports. The methodological process is summarised in Figure 2.3, tracing the systematic progression from initial data collection to final analytical outcomes (Tashakkori & Teddlie, 1998).

Given the import-dependent nature of Pacific SIDS, material imports are important to their production, consumption, and subsequent waste-management patterns. This study therefore examines material input records using national trade monetary figures. Material flow analysis conventionally uses physical mass data; however, consistent physical-mass import data for the three SIDS were not available at the time of the study. Readily available official monetary import statistics were therefore used as a proxy. As monetary value does not directly represent physical quantity, the resulting estimates are interpreted as indicative material-flow patterns rather than physical material-flow measurements. A formal mass-based economy-wide material flow analysis is undertaken separately in Chapter 4.

Figure 2.3. Data gathering process and summary outcomes



Source: Author

Quantitative data (Data A) consisted of an average of five years of material input records, including official imports and domestic extractions for Samoa (Samoa Bureau of Statistics, n.d.), Tonga (Tonga Statistics Department, n.d.), and the Cook Islands (Ministry of Finance and Economic Management 2021), categorised using the International Combined Nomenclature (CN) Code (World Customs Organisation 1988–2018) for consistency. The nomenclature in these data sets was reconciled with that in waste management systems (flows A1 and A2).

In parallel, qualitative data (Data B) were collated from a range of sources, including national plans, ministerial reports, and intergovernmental organisation documents from the respective nations, as well as regional frameworks such as the Pacific Regional Infrastructure Facility (PRIF) and Secretariat of the Pacific Regional Environment Programme (SPREP) reports, and

information from the media and NGO project websites. After cleaning the relevant data, supplementary reports were snowballed from the initial materials (flows B and C). These data provide a context for material flow, highlighting the policies, plans, and directives that shape the CE landscape in these nations.

Both data sets were then classified using the EMF CESD, as shown in Figure 2.2, Column 3. This enabled identification of baseline CE activities across the biosphere and technosphere, the results of which are presented in Table 2.1 (biosphere activities) and 2.2 (technosphere activities).

Table 2.1. Biosphere circular economic activities

Biosphere activities	Samoa	Tonga	Cook Islands
Biogas	There is an ongoing robust community biogas programme (IMPRESS Project) rolling out in Samoa. https://www.samoaobserver.ws/category/samoa/81756 https://www.homebiogas.com/blog/transforming-lives-and-landscapes-homebiogass-impact-in-samoa/?srsltid=AfmBOoo_awx9OOBJoM8bCmLnzQJ_na_dfiP-UhvsHyRH56OdAVHtJ24S Context: The Samoan Energy Plan 2017-2022 recorded a residential consumption of approximately 14.3% of total energy use in 2015. ***Source:***	Tonga is undergoing a feasibility study for a national biogas commercial facility which is named The Circular Economy Project. ***Source:*** https://www.ctc-n.org/system/files/dossier/3b/210120%20doc%20UNIDO%20to%20deliverable%202%20part1.pdf At a meso level, the Methodist boarding school Tupou College operates a promising biogas project. ***Source:*** https://matangitonga.to/2016/07/15/biogas-agriculture-could-be-tonga-s-ticket-booming-agro-economy Biogas projects have also been installed at residential	Biogas units were built with piggeries in the late 1980 and 1990 and were still working up to 2005. ***Source:*** http://www.sustainablesids.org/wp-content/uploads/2017/01/Cook-Islands.pdf

	https://policy.asiapacificenergy.org/sites/default/files/Samoa%20Energy%20Sector%20Plan%202017-2022%20%28SM%29.pdf	level. ***Source:*** https://matangitonga.to/2018/05/11/biogas-system-vavau-homes	
Compost	Attempt at commercial composting exists. ***Source:*** https://www.youtube.com/watch?v=C_oPaS6VFqg Samoa waste audit 2021 http://rio-samoa.mnre.gov.ws/sites/default/files/World%20Bank%20Samoa%20Report%20FINAL.pdf	Green solid wastes generally go to the garden as unprocessed compost. ***Source:*** p.2 https://www.adb.org/sites/default/files/publication/42660/solid-waste-management-tonga.pdf Small community projects have been rolled out. Integrated Lands and Agroecosystem Management System (ILAM) meso level tree planting projects, involving composting.	Households and businesses compost some of their green wastes. ***Source***: PRIF, *Waste Audit Report Cook Islands,* 2021, pp. 17 & 18[8] Composting and worm farms for schools programme. ***Source:*** https://www.youtube.com/watch?v=XSpUqv5pxvI

[8] PRIF, *Waste Audit Report Cook Islands Consultants' Final Report*, 2021. Retrieved, 04-04-2022, https://www.theprif.org/sites/default/files/documents/PRIF_WasteAudit-CookIslands_web.pdf

		Source: https://www.facebook.com/100008660228767/videos/2034709117280 20	
Animal feed	Feeding leftover food to animals is common practice in Pacific SIDS. ***Source:***	It is common practice to feed the leftover food to animals. ***Source:*** p.2 https://www.adb.org/sites/default/files/publication/42660/solid-waste-management-tonga.pdf	Some businesses make arrangements to provide food wastes for animal feed. Also some households feed their animals from household scraps. ***Source:*** Ibid.
Anaerobic digestion	The biogas and composting community projects in Samoa, go through anaerobic digestion when the organic material (feedstock) turns into gas. ***Source:*** https://policy.asiapacificenergy.org/sites/default/files/Samoa%20Energy%20Sector%20Plan%202017-2022%20%28SM%29.pdf	Tonga's national biogas project undergoing feasibility study. Anaerobic digestion is a natural part of this process. ***Source:*** https://www.ctc-n.org/system/files/dossier/3b/210120%20doc%20UNIDO%20to%20deliverable%202%20part1.pdf	There are default occurrences of anaerobic digestion when green and the biodegradable solid waste end up in the landfill (21% are organic and 25% are paper wastes). ***Source:*** Ibid. p.37

Cascading/ Reuse	Old materials are known to be used for new items or repurposed objects. In this example it's old building materials used in a new building. ***Source:*** https://www.rnz.co.nz/international/pacific-news/203111/demolition-work-has-begun-on-samoa%27s-old-fono-building	Making doormats from old cloth was a common practice in Tonga in the 70s. ***Source:*** Illustration only. https://www.youtube.com/watch?v=SUj7ozZcPB4&t=7s	Reuse of biodegradables include: Reusable feminine hygiene products. ***Source:*** The Maine Mura programme Second-hand shops: SPCA op shop; Tivaevae cultural gifts. ***Source:*** SPCA op shop. Tivaevae cultural gifts.

Source: Biosphere survey results for Samoa, Tonga and Cook Islands

Table 2.2. Technosphere circular economic activities

Technosphere activities	**Samoa**	**Tonga**	**Cook Islands**
Reuse	There are preloved clothing shops in Samoa. Traditionally, the stocks of preloved shops in Pacific SIDS are imported. Buy and sell online communities have emerged with popular social media like Facebook. ***Source:*** https://www.facebook.com/groups/359676187549853/	Tonga had a bustling second-hand market prior to Covid-19. Locally known as the *fea (flea market).* Products are sent from relatives overseas. ***Source:*** https://www.jstor.org/stable/4149867 Reusing old vehicle tyres to build school playground ***Source:*** https://matangitonga.to/2021/07/15/new-playground-beulah-adventist-primary-school	Rent a plate at the food market for a gold coin. ***Source:*** Punanga Nui Market Facebook page. https://www.facebook.com/tiscookislands/posts/1477181405949076
Recycle	Plastic is shredded and moulded in Samoa and turned into certain products by an entrepreneur, Andrew Pedrana. ***Source:***	Tonga Waste Limited is a state owned enterprise. It has five recycling machines including a plastic shredder, two glass crushers, and two plastic balers. The products from the processing machines can only be exported. Tonga does not have the capacity and technology to process all of it.	Cook Island General Transport Recycling 60% of recyclable materials. These target recycling markets overseas, mainly New Zealand.

	https://www.greengrowthknowledge.org/case-studies/plastic-recycling-initiative-samoa Project SRWMA collects a range of recyclable materials. Not all have got a ready or sustainable market. ***Source:*** https://www.facebook.com/watch/?v=3039818136284772	***Source:***https://matangitonga.to/2022/04/28/tonga-starts-recycling-plastic-and-glass Young business women greenpreneurs. PR focus. ***Source:*** https://matangitonga.to/2021/11/26/15-young-business-women-become-greenpreneurs	***Source:*** https://ici.gov.ck/zero-waste-cook-islands/rubbish-collection/
Refurbish	Furniture repair and upholstery services: **Island upholstery** *Source:* https://www.facebook.com/Island-upholstery-1529534313992356/Source 2. Automotive and all other types of repair shops throughout Samoa	Furniture repair and upholstery services: 1. Star Upholstery Tonga ***Source:*** https://www.facebook.com/Star-Upholstery-Tonga-985862768137577/ 2. Automotive and all other types of repair shops throughout Tonga	Computer repair shops 1. Techtro Solutions ***Source****:* Techtro solutions Cook Islands 2. Automotive and all other types of repair shops throughout the Cook Islands
Re-manufacture	Making bricks out of glass bottles. These bricks are used for retaining walls and fence. ***Source:*** https://www.facebook.com/Samoa-	Using remnants of unused clothing and material to make useful items such as masks, scrunchies and bags. Raleny https://www.facebook.com/Raleny-105051464209714	Cook Island General Transport is making plans to remanufacture waste plastic materials.

	Recycling-Waste-Management-Association-SRWMA-1977094658969548/	***Source:*** Matangi Tonga Media. Fisi'ihangale community group. Using unused old objects to enhance crafts. ***Source:*** https://matangitonga.to/2020/05/21/master-carver-trains-fisiihangale-community-group	***Source:*** https://ici.gov.ck/zero-waste-cook-islands/rubbish-collection/
Redistribute	Material objects get redistributed through giftings. ***Source:*** https://www.giftcanyon.com/samoan-gift-giving-101/	Material objects get redistributed through giftings. ***Source:*** https://culturalatlas.sbs.com.au/tongan-culture/tongan-culture-etiquette	Outer island group have communal hostels. Also tourist accommodation. Outer islands boarding needs are communally provided (shared facilities). See the link below for one example. ***Source:*** https://evendo.com/locations/cook-islands/atiu/landmark/atiu-hostel

Source: Technosphere survey results for Samoa, Tonga and Cook Islands

Raw data from Tables 2.1 and 2.2 were subsequently assigned weighted values to reflect more realistically each indicator's contribution to total CE activities in each SIDS. These results were weighted and summarised using the parsimony principle (Stango et al., 2017; Gabaix & Laibson, 2008) according to (a) official reports of biomass results (0.5:1); (b) understanding of country conditions relative to the biomass results (0.2:1); (c) prima facie viability of the identified CE undertaking and an assessment of market viability (0.2:1); and (d) the authenticity of reported projects (0.1:1).

The weighting scheme was researcher-defined, with weights assigned according to the relative evidential strength of each criterion. Such explicit weighting is consistent with approaches that combine multiple criteria using weights to reflect their relative importance (OECD/European Union/EC-JRC, 2008; Greco et al., 2019). Officially reported results were assigned the greatest weight (0.5) because they provided the strongest and most verifiable evidence. Knowledge of country conditions and the prima facie viability of the identified CE activity were each assigned an equal secondary weight (0.2), reflecting their importance in interpreting the reported evidence within the relevant local and market contexts. Project authenticity was assigned a smaller confirmatory weight (0.1). The four components were deliberately kept simple and collectively summed to one, consistent with the principle of parsimony applied in the analysis. After allocating the weights, a percentage of the total was calculated for each CE activity, as shown in Tables 2.1 and 2.2 and summarised in Table 2.3.

$$W_A = A\ x\ (0.5W_{\text{report}} + 0.2W_{\text{country}} + 0.2W_{\text{market}} + 0.1W_{\text{authenticity}})$$

Where:

- A is the value of the activity.
- W_{report} is the weight assigned to the official reports of the biomass results (0.5).
- $W_{country}$ is the weight assigned to the understanding of the country's conditions relative to the biomass results (0.2).
- W_{market} is the weight assigned to the assessment of market viability for the identified CE undertaking (0.2).
- $W_{authenticity}$ is the weight given to the authenticity of reported projects (0.1).

The weighted activity scores were then used to calculate the relative contribution of biosphere and technosphere activities in Table 2.1 and 2.2. These values were summarised in Table 2.3.

Table 2.3. Weighted averages from Table 2.1. and Table 2.2.

Biosphere regenerative activities Samoa		**Biosphere regenerative activities Tonga**		**Biosphere regenerative activities Cook Islands**	
Biogas	13.80%	Biogas	1.40%	Biogas	0
Compost	1%	Compost	1%	Compost	1%
Animal feed	3%	Animal feed	3%	Animal feed	3%
Anaerobic digestion	5%	Anearobic digestion	5%	Anaerobic digestion	5%
Cascading/Reuse	1%	Cascading/Reuse	0.01%	Cascading/Reuse	0.01%
Technosphere preservation activities Samoa		**Technosphere preservation activities Tonga**		**Technosphere preservation activities Cook Islands**	
Reuse	2%	Reuse	3%	Reuse	1%
Recycle	2%	Recycle	1%	Recycle	5%
Refurbish	3%	Refurbish	2%	Refurbish	1%
Remanufacture	2%	Remanufacture	1%	Remanufacture	0
Redistribute	5%	Redistribute	5%	Redistribute	5%
TOTAL B&T	37.8%	TOTAL B&T	22.4%	TOTAL B&T	22%
Capital Stock & landfill	**62.2%**	**Capital Stock & landfill**	**77.6%**	**Capital Stock & landfill**	**78%**

Round to one decimal place

Source: Author

The remaining material destination figures were acquired from: a) capital stock less Intangibles from the National Accounts for each SIDS, and b) Balance unaccounted for after assigning values to the identified CE activities and capital stock. Hence:

- CS: Given value for capital stock after subtracting intangibles (as given in the National Account)
- CL (Consumption to Landfill): Calculated as the balance after other destinations have been considered.

$$CL = T - (\sum W_B + \sum W_T + CS)$$

Where:

- T is the total material input.
- $\sum W_B$ is the sum of weighted biosphere activities.
- $\sum W_T$ is the sum of weighted Technosphere activities.
- CS is the given value for capital stock.
- CL is the balance value for consumption to landfill.

The total material flow (D) destination would be:

$$D = (\sum W_B + \sum W_T + CS + CL)$$

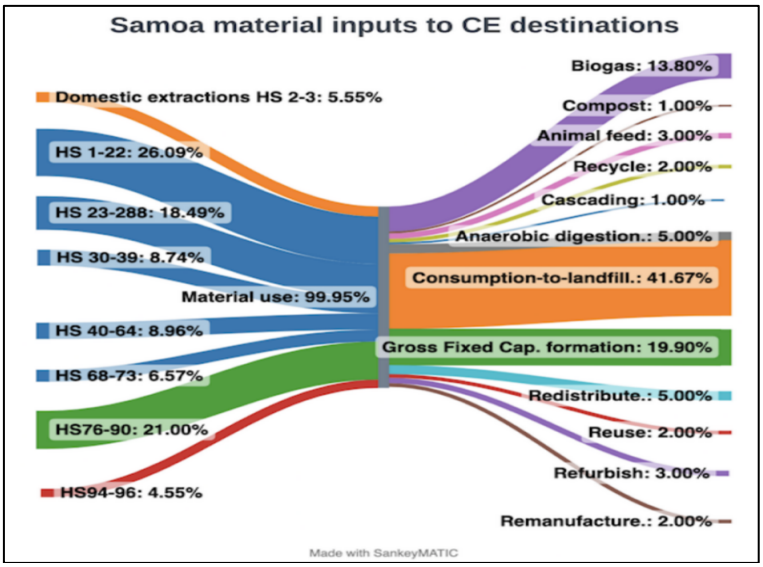
2.3.1. Visual representation of material flows

Figures 2.4 to 2.6 show a visual representation of material flows for Samoa, Tonga, and the Cook Islands. Input categories were aligned with the international Harmonised System (HS), grouped into the following clusters for readability.

- Edible and tobacco products (HS I–IV),
- Inedible consumables (HS V–VIII),
- Wood and leather-based products (HS IX–XII),
- Light stone and metal-based products (HS XIII–XVII),
- Light equipment and others (HS XVIII–XXII).

Domestic extracts of material flows for Pacific SIDS include agricultural, fishery, marine, and animal (primary) products. The GDP data for the sum of the primary products were used to represent domestic extractions. Similar figures appear to be the export figures for the Cook Islands, although they are not explicit for Tonga. For this reason, GDP primary product figures are used as representatives only for domestic extraction. Furthermore, rounding errors can occur.

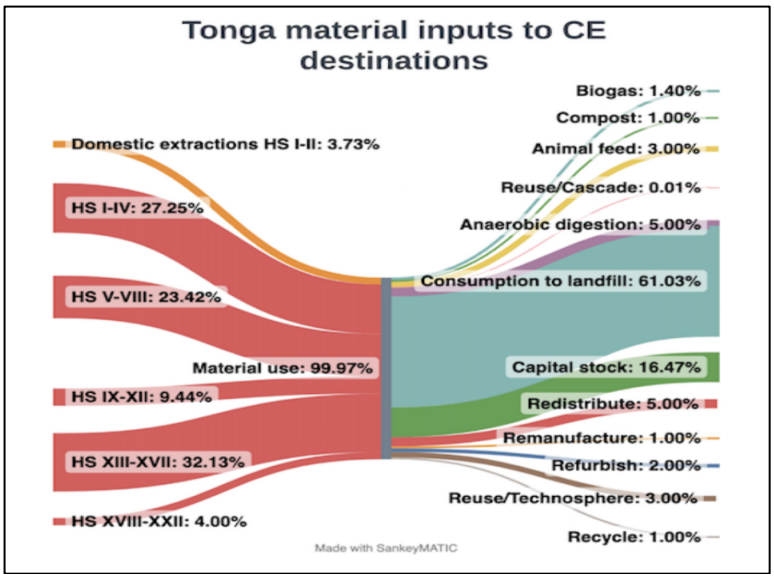
Figure 2.4. Samoa material inputs to CE destinations[9]



Source: Author's application of SankeyMATIC online

[9] Author's construct from national imports to CE destinations and end-of-life weighted data (Table 2.3).

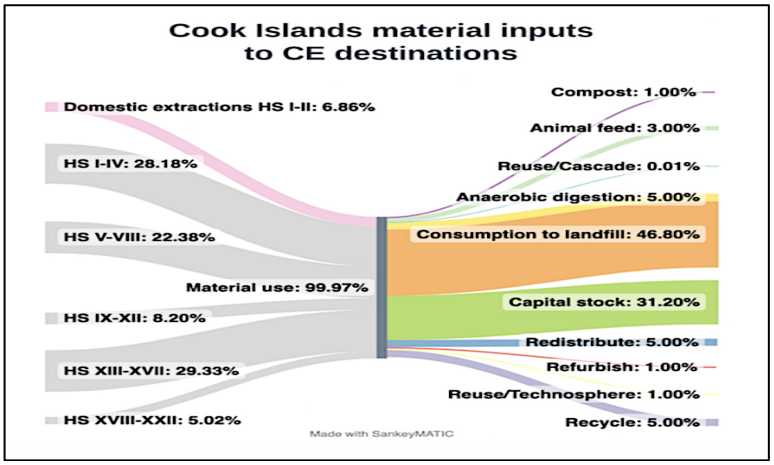
Figure 2.5. Tonga material inputs to CE destinations[10]



Source: Author's application of SankeyMATIC online

[10] Ibid.

Figure 2.6. Cook Islands material inputs to CE destinations[11]



Source: Author's application of SankeyMATIC online

In parallel, *CE-related policy documents* identified through qualitative data analysis were examined from an *institutional coevolutionary perspective*, as elaborated in Section 2.5.

2.3.2. Institutional coevolutionary analysis perspective

This study adopts Evolutionary Governance Theory (EGT) to analyse how material-economic factors, institutional structures, and discourse interact to shape governance outcomes in the CE space. Originally applied in European energy transition contexts such as Denmark, Sweden, and the Netherlands (Kooij et al., 2018), EGT is used here to reveal context-specific enablers and barriers to CE initiatives across the three Pacific SIDS.

The Material-economic dimension

The material-economic dimension includes but is not limited to conventional factors of production, investment decisions made by capital owners (what products and materials are to be manufactured), and the extent and patterns or path dependencies of resource distribution

[11] Ibid.

(how far the extracted resources are exported beyond the source state or country). From the perspective of the Pacific SIDS, material-economic considerations lean towards imports, and potential substitutes that are beneficial to the people and the environment can be created locally. This implies the revitalisation of traditional methods before the influx of material imports. New economic opportunities will follow, along with the potential for jettisoning import externalities, such as imported inflation, nonbiodegradable packaging, and unhealthy food.

The Actor-institutional dimension

The CE implications for material-economic inputs (both imports and domestic extracts) do not transpire in a vacuum. Actors bring them to bear through institutions and methods enabled by regulations. Relevant actors, platforms, networks, and formal and informal institutions are of interest in actor-institution dimensional analysis, as are the rules that guide the actions and interactions of the actors and how easily they have access to policy formulation and the implementation process (Kooij et al. 2018). Considering governance at the actor-institution level, free trade policies allow for a wide and free distribution of materials and products across the globe. Such enabling policies (free trade), shipping companies, importers, and their purchasing patterns establish path dependencies that influence production and imports, or otherwise healthy communities and the environment.

The Discursive dimension

Discourse shapes how problems and solutions are framed, and thus which policies are considered legitimate or feasible. In the context of Pacific SIDS, dominant development narratives, often imported from donor countries, can overshadow Indigenous ecological knowledge and community-led solutions. The discursive dimension functions like the lubricant in a machine, not immediately visible, but essential. It mediates power, meaning-

making, and access to influence. Understanding how CE is discussed, by whom, and with what authority, is critical to understanding governance outcomes.

2.4. Findings

2.4.1. Material flows and end of life destinations in three Pacific SIDS

The operation of the Harmonised System classification is compatible with the system of production and consumption for Pacific SIDS (i.e., import-reliant). This embedded reliance on imported goods, reinforced by dominant economic development narratives, has normalised extractive consumption models. As a result, sustainability efforts often default to waste management measures such as licensing regimes and proposed levies, that can disproportionately burden local populations and risk exacerbating environmental and social inequities.

This myopia results in a regulatory-heavy approach characterised by control, licences, and proposed levies, which disproportionately burdens the majority of the SIDS population and steers the ST towards an injustice trajectory. However, within the HS classification, remedial avenues can be found for production and consumption, given that remote SIDS have long-survived histories and traditions.

2.4.2. Waste management CE policy priorities

Waste management (WM) policy priorities involving the three SIDS display a predominantly reactive and mandatory orientation, with limited attention to social equity. They are regulatory-based, dominated by controls, licences, and the levy system's self-financing implications, to be imposed on medium – to - low-income populations.

An assessment by the Secretariat of the Pacific Regional Environment Programme (SPREP, 2020) evaluated the WM legislative framework of nine Pacific SIDS, including Samoa, Tonga, and the Cook Islands, across nine policy domains:

1. Dedicated WM legislation
2. Regulation of specific waste streams
3. Hazardous waste management
4. Sustainable waste financing
5. Import prohibitions or levies
6. Licensing and environmental impact control
7. Compliance and enforcement mechanisms
8. Polluter-pays cost recovery
9. Planning, reporting and information systems

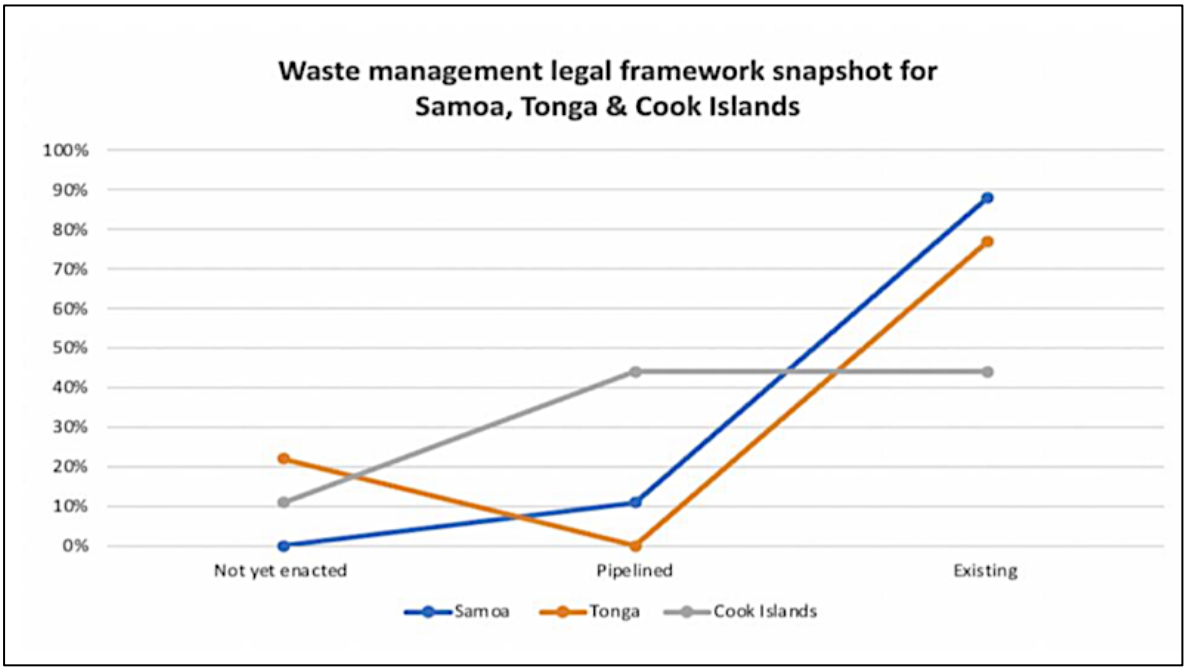
If fully implemented, each domain contributes equally to a composite 100% score.

The current status of solid waste management (SWM) policy implementation, as summarised in Figure 2.7 shows varying degrees of progress. Samoa leads, having enacted all but the "sustainable waste-financing system," which is yet to be in the pipeline, achieving just under 90 percent implementation. The Cook Islands have fully enacted four areas, resulting in 44 percent implementation, and have another four areas in the pipeline accounting for 44 percent. Tonga has fully enacted seven of these areas but has yet to address two, with no areas currently in the pipeline, standing at 78 percent implementation and 22 percent pending action.

These differences suggest that policy implementation is shaped not only by technical capacity but also by political judgement regarding the public's willingness to absorb costs. Samoa's

relative success in renewable energy transition lends weight to this interpretation, highlighting the role of public trust and policy legitimacy in enabling sustainability reforms.

Figure 2.7. Waste management legal framework snapshot for the 3 SIDS



Source: Author's reconstruction of the SPREP, 2023 Pacific SIDS WM legislative assessment.

2.4.3. Transition to green energy

Three SIDS studies demonstrated the implications of justice (Bertolino et al. 2023) in energy transitions. The thriving community biomass programme in Samoa has continued to grow. An exemplary transition to a decentralisation approach removes the governance and institutional costs. Benefits flow directly to the community members who own the project. Biomass facilities have low initial capital requirements, and their subsequent maintenance is relatively minimal. At the other extreme, Tonga centralised the energy transition from solar and wind farms to their planned biogas facility. In contrast to Samoa in cutting out unnecessary costs and allowing the flow of benefits directly to consumers, Tonga is enmeshed in high capital costs, high technical learning and maintenance costs, governance, and administrative complexities

with high staff turnover at all industry levels, with problematic services and increasing costs to consumers. The Cook Islands enjoy a steady approach to green energy transition, consistent with an industry-flat management structure in harmony with their small population size.

The three Pacific SIDS each wrote their national commitments to renewable energy in their national plans, as well as their five-year Nationally Determined Contribution (NDC) (Government of Samoa 2021; Tongan Government 2020–2021; Cook Islands Government 2016). Data used in this study were drawn from Samoa (International Renewable Energy Agency [IRENA] 2022b), Tonga, and the Cook Islands' energy profiles on the IRENA (2022a) website. The latest data were obtained in 2019 and reported in 2022. Nations' energy supply sources change continually as governments endeavour to fulfil their National Energy Roadmaps. For instance, Tonga launched a six-megawatt solar farm in December 2022 (Leatinu'u 2022), adding an almost 200 percent increase to its existing solar-supplied energy. This plant has yet to install battery storage facilities.[12] Furthermore, Samoa's 2017 to 2022 Energy Sector Plan (Ministry of Finance, Government of Samoa 2017) expected an increase in its solar-supplied energy to 6 percent, a 400.5 percent increase.[13]

According to IRENA data:

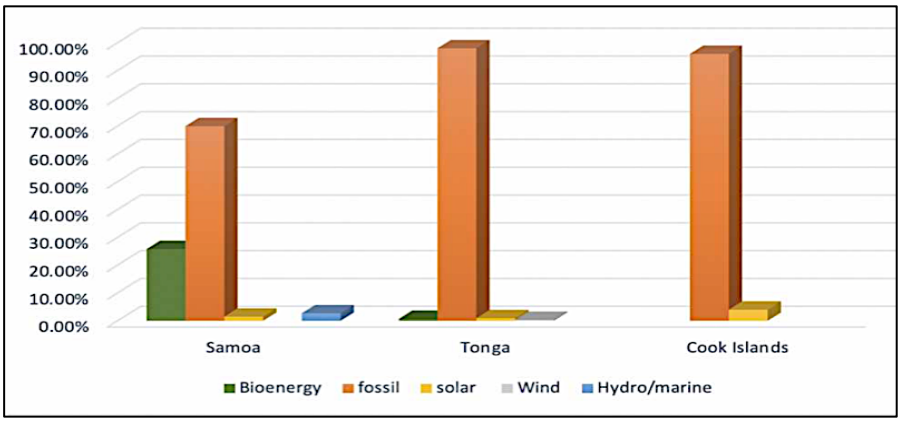
- Samoa sources approximately 70% of its energy from fossil fuels, 25.8% from bioenergy, 2.7% from hydro (including marine), and 1.5% from solar.
- The Cook Islands remain 95% reliant on fossil fuels, with 5% from solar.
- Tonga has a 97% fossil-fuelled energy system, with 2% solar and 1% from other

[12] Sustainable transition in SIDS occurs at a rapid rate, and research results can be out of date by the time of publication.
[13] Rounding errors exist.

renewable sources.

These figures underscore the continued dominance of fossil fuels, but also point to divergent transition trajectories influenced by governance models, institutional capacity, and cultural alignment with decentralised or community-led approaches. The results are shown in Figure 2.8.

Figure 2.8. Energy sources for the 3 SIDS



Source: author's summary of green energy composition for 3 SIDS

2.4.4. Reforestation

Reforestation activities in the three Pacific SIDS reflect broader governance approaches to biosphere restoration. Samoa has adopted a sustained and proactive national programme, while Tonga's efforts appear more limited and less well-documented. The Cook Islands follow a distinctive model rooted in private land ownership and multifunctional forest use.

Samoa launched an ambitious reforestation programme between 2015 and 2020, achieving its goal of planting 2,215, 756 trees across forests, parks, coastal zones, and low-lying areas (Ministry of Natural Resources and Environment, Samoa 2021). The programme has

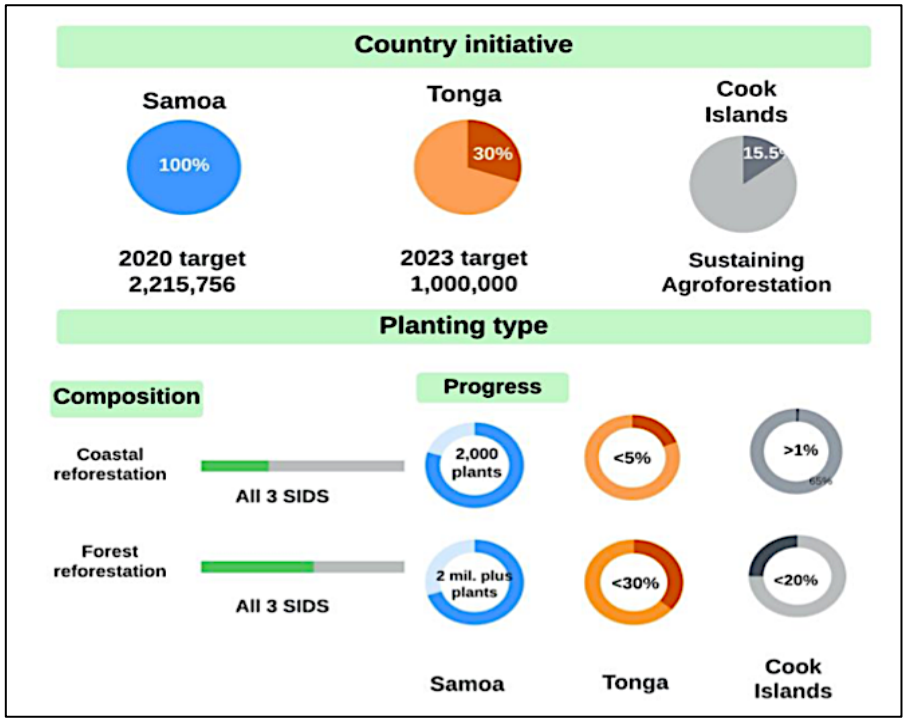
continued beyond its initial target, supported by government and civil society (Samoa Observer 2021; Samoa Conservation Society, 2021.).

Tonga committed to planting 1,000,000 trees by 2023. However, public reporting and independent assessments suggest that this effort has lacked transparency and verifiable outcomes, especially when compared with Samoa's more robust and community-visible approach (Loop Pacific, 2020; European Union, 2020; TBC, 2020).

In the Cook Islands, reforestation is embedded in a broader, holistic view of land use that integrates environmental sustainability with local livelihoods. Forest management includes the cultivation of food crops, native plants, and ferns, supporting both biodiversity and community needs (PAFPNet 2016). All forest land is privately owned, which differentiates Cook Islands' forestry governance from the more centralised models in Samoa and Tonga. According to the Forest Resources Assessment (2010), forest cover in the Cook Islands was 15.5 percent in 2005, although updated figures are not available.

These contrasting approaches illustrate how institutional arrangements, land ownership structures, and cultural values shape CE-aligned reforestation strategies across Pacific SIDS. The results are summarised in Figure 2.9.

Figure 2.9. Reforestation Programme for 3 SIDS



Source: Reforestation research results for Samoa, Tonga and Cook Islands

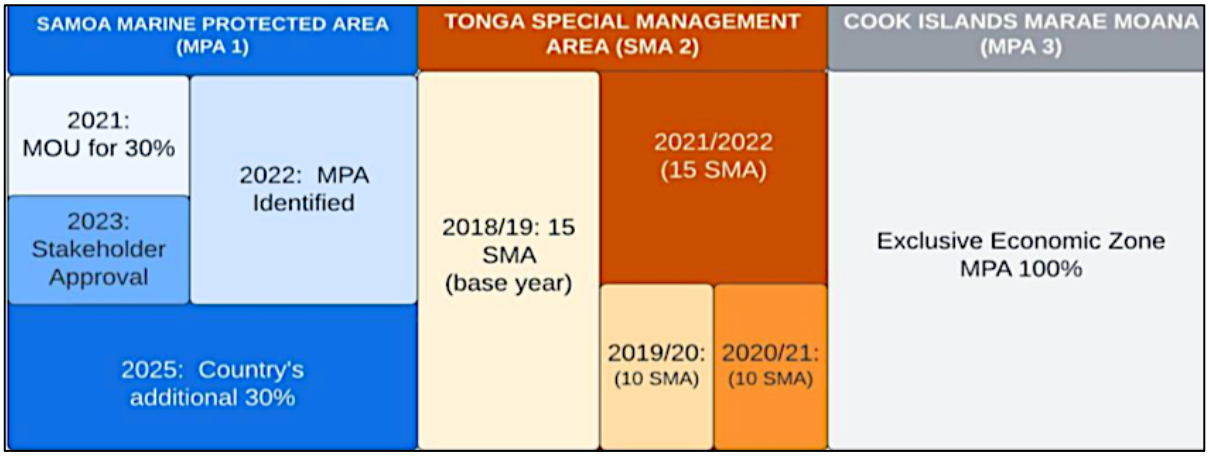
2.4.5. Marine management

As a restorative strategy, marine management has been embraced by the three SIDS for varying reasons. Samoa and the Cook Islands took opportunities to bring the largest areas of ocean space available to them under marine management strategies. Each took coordinated steps to extend marine protection across the largest practicable areas of their exclusive economic zones (EEZs) for conservation and resource sustainability. The Cook Islands has designated Marae Moana, a marine park covering 1.9 million square kilometres of the Pacific Ocean, making it one of the largest in the world (OECD 2016). Samoa has committed to expanding MPA coverage to 30 percent of its EEZ through a five-year plan initiated in 2021. These regimes not only conserve biodiversity but also open equitable opportunities for local communities to engage in marine governance and sustainable fisheries.

In contrast, Tonga has adopted a Special Management Area (SMA) regime (Smallhorn-West et al., 2020), which reflects its broader trend toward centralisation and bureaucratic governance. SMA implementation requires extensive oversight, including increasing demands for Fish Habitat Reserves (FHRs) and zone demarcation. The number of local trustees overseeing these SMAs is low particularly in Tonga's dispersed island geography. This creates reliance on neighbouring communities and fosters inter-community surveillance, a dynamic colloquially described as *tu'akoi-'a-'ofato* (back-to-back wood-worm abode), which reflects emerging social alienation.

Tongan coastal communities have historically engaged in flexible, need-driven fishing practices, venturing beyond local waters to meet subsistence needs. Under the current SMA regime, these traditional practices are restricted, potentially reducing food access and economic opportunities. Such constraints may exacerbate inequities and undermine the resilience of communities that have relied on adaptive and place-based knowledge systems. Figure 2.10 presents the ocean management regimes for the three SIDS.

Figure 2.10. Ocean management regime for the 3 SIDS



Source: Ocean management regime research results for Samoa, Tonga and Cook Islands

2.5. Institutional coevolutionary analysis for Samoa, Tonga and Cook Islands

The coevolutionary analysis of governance across Samoa, Tonga, and the Cook Islands builds on the empirical findings above by drilling deeper into how actor institutional, material-economic, and discursive dimensions interact (Kooij et al., 2018). While the three SIDS exhibit varying policy outcomes, this analysis reveals that each also possesses distinct institutional strengths and sociocultural capacities that can be mobilised to craft context-specific CE strategies.

From a coevolutionary governance perspective (Kooij, 2014), these differences are not shortcomings but strategic opportunities. Rather than applying one-size-fits-all CE templates, often externally designed, the three SIDS can leverage their existing cultural values, institutional arrangements, and material realities to develop CE pathways that are both effective and just. The key lies in identifying which configurations of actors, discourses, and material flows are best suited to each setting.

Crucially, ensuring that these transitions are inclusive and equitable will require awareness of the underlying *technologies of power* (Kooij, 2014), that is, the often-invisible structures and narratives that shape how policies are made and implemented. By recognising and addressing these forces, Samoa, Tonga and the Cook Islands can strengthen their capacity to guide the incoming tide of CE models, avoiding extractive or exclusionary outcomes and instead fostering regenerative, locally grounded transition.

2.5.1. Material Economic

The material-economic dimension presents economic aspects and path dependencies that influence opportunities (Kooij et al., 2018). Under ecological economics, new "opportunities" must now be interpreted as the neo-global common goal for humanity to live in an ecologically safe and socially just space.

From the perspective of Pacific SIDS, the right to self-determination is central. Therefore, the subjects of this material-economic analysis are material inputs, their circular economic enabling or restrictive conditions, institutions, and trade path dependencies underpinned by energy.

In Pacific SIDS, material inputs are largely shaped by import dependency, with foreign-supplied goods forming the backbone of production and consumption. This reliance creates structural limitations for CE adoption, often locking in extractive and linear economic models. However, it also presents an opportunity: to reclaim agency by developing locally attuned substitutes and regenerative practices that reduce external dependencies, mitigate environmental costs, and support economic resilience.

2.5.2. Material Economic for Samoa, Tonga and the Cook Islands

The commitment to renewable energy is more advanced in Samoa than in the other two SIDS, with almost 30 percent implementation (Figure 2.7). New industries such as biogas and hydropower plants have emerged to form new supply dependencies. Similarly, new grassroots institutions have surfaced. Where necessary, active decentralisation occurs (e.g., supply-based biogas community), shifting the economic benefits directly to the people. This is enabled by

the ingrained “fa‘asamoa” - Samoan way of life (Tupuola 1994). A cultural system based on multidimensional intergenerational trust and reciprocation is built on the responsibilities shared by society. Fa‘asamoa is deeply embedded in its people, an enduring dependency pathway that, according to the findings of this research, drives SD requirements to serve locally while accounting globally. Accordingly, Samoa’s Ecological Footprint is a planetary level better than Tonga. (Circularity Gap Report, 2022, 38).

The Cook Islands is not included in the Circularity Gap Report. At 237 square kilometres, it is one-third the size of Tonga (748.5 square kilometres). The main influence on the material-economic factors of the Cook Islands is similar to that of Samoa, that is, the chiefdom culture based on kinship, “The House of Ariki [Chiefs] of the Cook Islands.” Policies affecting the Cook Islands have been approved by the House of Ariki. The Cook Islands Constitution, Part I, Clause 2, The Head of State, establishes the authority, functions, members, procedures, and privileges of the House of Ariki (Cook Islands Ministry of Foreign Affairs and Trade 1964). This ensured that the people of the Cook Islands were the prime beneficiaries when answering the twin targets of the SDGs and NDCs. This also acts as a shield for self-determination when implementing the SDGs and NDCs. In contrast to Samoa, where the transition to renewable energy is relatively advanced, the Cook Islands drive their SWM strategies because they directly affect the tourism industry, from which over 60 percent of the SIDS’s GDP is derived. Additionally, the decision to confirm a successful Marae Moana Ocean Management regime was grounded in the cultural chiefdom system (Maki 2014). Conservation International (n.d.) blog site states:

> Cook Islands’ culture is rooted in a respect for and reliance on nature. Livelihoods are closely associated with land and sea health. Supported by traditional leaders, the Cook Islands’ government first announced its commitment to the Marae Moana

> marine park in 2012… Its purpose: to promote SD and balance economic growth with conserving the ocean's natural resources.

Tonga, by contrast, tends towards bureaucracy and centralisation, as revealed in this study, to disadvantage material-economic prospects for the people. This paper contends that this is due to the complex customs surrounding the chiefdom structure. A hierarchical construct with the king at the top, the nobles of the realm next, the matāpule (attendant/orator) who are oratorial and genealogical conduits between the people of the land, and the head of clans (estate holders). Matāpules maintain proprietary spaces between leaders and people. This social practice is accompanied by hala (presented gift) (Evans 2001). Hala is the cultural "consideration" (as in a contractual relationship - in this case, a cultural understanding). Hala must be acceptable, and the higher up in the hierarchy, the bigger and more expensive the hala should be. In the Tongan measure, Toho (oldest or biggest most worthy gift), as in kava - kava toho, pig - puaka toho, and so on, are the appropriate considerations. From this cultural worldview, it is surmised that Tonga's political leaders tend to create utility for the people by assuming bureaucratic and centralised structures. In doing so, they overlook material and economic necessities.

Tonga is currently pipelining its third diversified renewable energy project to add to the previous solar and wind farms (The Climate Technology Centre and Network [CTCN] 2019; Ma'u 2019). The biogas project, also known as the CE project, requires agricultural and husbandry-based skills as well as land-based resources to cultivate feedstock for the biogas facility, creating a new industry to rely on, and bureaucratic dependency not previously tested. At the gloss of renewable energy advocacies, the elements of the "system functions" that contribute to the success of biogas systems (Negro et al., 2007, 933–934) have been overlooked. Path dependencies for material economics were labelled by Negro et al. as the

"lock-in" of the established system relative to biogas infrastructure projects. Tonga treats its project as purely economic, with promoted socioeconomic benefits, without the coordination of other necessary "lock-in" factors. The system functions' considerations are in line with the Biogas Digestion: Economic and Asset Assessment for Missouri (2020). Without the stated "lock-in" or newly created path dependencies, projects will not succeed. Tonga lacks the industries and institutional infrastructure required to buttress such national biogas facilities in developing countries.

2.5.3. Actor institutions

In contrast to OECD countries, Pacific SIDS lack the market depth required to independently cultivate viable CE initiatives. However, prominent are international financial institutions such as the World Bank (WB), Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), and the Green Climate Fund (GCF). These institutions provide guidelines that seek shifts in supplier and consumer behaviour, which are frequently referenced as the need for a paradigm shift. Most importantly, they provide conditions for borrowers' financial independence, hence institutionalising a user-pay for services that is often established upon financing expediency instead of commercial viability. This is consistent with the institutionalisation of the alleged needs of society enabled by institutional financiers. The power relations between these OECD institutions and the Pacific SIDS are dominant. This dominant influence is ingrained in governance through a growing number of policies and public dependence on institutional actors.

2.5.4. Actor institutions for Samoa, Tonga, and Cook Islands

Samoa, Tonga, and the Cook Islands have committed themselves to achieving the requirements of SDGs and NDCs. The SPREP and PRIF, or the South Pacific Commission (SPC), progressively centralise institutional information, rules, and guidelines. An example is shown in Figure 2.7. Additionally, external actors, particularly UN agencies and international financial institutions (e.g., WB, ADB, JICA) shape policy environments by offering technical support, often tied to standardised templates that do not fully account for local specificities (Roe 1991). These influences are embedded in national development strategies, annual budgets, and implementation plan.

How each Pacific SIDS handles the influences involved in the actor institutional dimension can either pass on economic benefits to the grassroots level or drive the economic gap wider between the "haves and the have-nots." Furthermore, handling the influence of the actor's institutional dimensions could protect or surrender their Pacific SIDS sovereign rights and self-determination. This is demonstrated by their adoption of marine ecosystem protection regimes (Figure 2.10).

By adopting the MPA regime, Samoa and the Cook Islands gain additional ocean areas that are not limited to their previously held EEZ. Resource prospects are protected for their exclusive discretion, and the food supply from the ocean broadened, resulting in material economic advantages, all of which buttress self-determination. Tonga divides its national coast into SMAs (Kingdom of Tonga, SMA, 2020). Local SMA owners police their own SMA for exclusive enjoyment. An intrusive bureaucracy that divides neighbouring communities that are not only blood related through intermarriages but also act as their first call for assistance during natural disasters and outside intrusions. Based on SMA maps, the most convenient fishing area

for the local community, an average of 12.6 percent (Smallhorn-West et al. 2020) of the SMA was marked as an FHR. The bureaucracy administrating the SMA requires periodic assessment of the FHR (Gillett, 2017). Smallhorn-West et al. (2020) published the impact of Tonga's oldest SMAs and their associated FHRs. The SMAs showed a low to no effect and was similar to the FHRs, apart from one exception of high impact for the island of Nomuka. Arguably, the SMA regime for Tonga is an intrusive bureaucracy that ringfences locals (an average of 128 persons per coastal SMA for forty-three out of the fifty-one SMAs) from their customary food supply through the FHR, a conservation management measure that leans towards progressive restriction given the deteriorating weather trajectory experienced by the Pacific. This disempowers people, leading to reliance on external aids that consequently erode self-determination.

However, Samoa has demonstrated that decentralising its biogas green energy initiative can have a direct economic impact on households. In the Cook Islands, private ownership by recycling enterprises has proven to be efficient. While institutional financing facilitates various projects, these initiatives are not necessarily sustainable. A similar situation exists in Tonga, where foreign donors fund piecemeal projects for SWM that fail to endure.

Across all three SIDS, the influence of external funders, while enabling access to capital and technical expertise, frequently results in project duplication, weak local adaptation, and limited sustainability, raising questions about long-term resilience and control.

2.5.5. Discursive dimension

The three Pacific SIDS have different dominant ideas and cultural structures that provide different outcomes to their varying interpretations and/or adoptions of the conventions and

international agreements from which the SDGs and NDCs originate. Historical foreign and developmental relations also contribute to discourse outcomes. The creation and empowerment of non-traditional institutions, such as civil societies and nongovernment organisations, bring with them new discourses and ideals.

From a coevolutionary governance perspective, discourse is not a passive backdrop but an active dimension of governance. Changes in discourse, whether introduced externally or evolving internally, can shift power dynamics, reframe policy debates, and reconfigure institutional arrangements. As such, none of the three governance dimensions (material-economic, actor-institutional, and discursive) are static. A transformation in one inevitably reverberates across the others, reshaping the entire governance landscape.

2.5.6. Discursive dimension for Samoa, Tonga, and Cook Islands

The traditional Samoan chiefdom, rooted in kinship structures (Wikipedia, n.d.), is intertwined with the central administration of government by virtue of elections based on an inbuilt community influence. Dominant discourse and ideals have a default cultural platform that is embedded in path dependency. Once a discourse subject is approved by this embedded platform, the system of kinship (i.e., the nation) begins to work through the central government institution. Reforestation and biogas projects have also been attested to in this issue. Samoa's cultural institutional makeup enables and empowers all three institutional dimensions.

This contrasts with Tonga's discursive context. The chiefdom structure centres on the king and cascades down to the nobles and their blood-related mātu‘a tauhi fonua (men tending to the land proxies). Matāpule is the layer after the proxy chiefs mātu‘a tauhi fonua; in some cases,

the same. At the family level, the Fahu (family ceremonial head—the father's sister and her children) tops the family pyramid (Thomson 1894; Fusitu'a et al. 2023). System of pyramids within village pyramids under a national pyramid. Dominant discourses were born and developed within this multi-tiered system. Additional complexity was created by the adoption of a democratic government (the 2010 reform). Its introduction was justified by discrediting the status quo, alleging that the traditional structure was undemocratic and dubbing nobles oppressive in a system that sustained their class hegemony (ABC News 2010). The consequence was the rise of a new institutional focus and modern political Lords or Nobility equivalents, the Ministers of the Cabinet. Temporarily, by virtue of election success, a disempowering layer of complexity creates a ferment in political competition. National guardianship shifted to political guardianship. SD packages, with their initial enabling finances, are channelled into political discourse. While plans and action plans are in place, Tonga's endeavours are trapped in the chaotic distrust and greed of politics, resulting in inauthentic outcomes as evident from the findings. This is in stark contrast to Samoa and the Cook Islands.

The chiefdom system in the Cook Islands, known as the Houses of Ariki, has enabled discursive success, such as the Marae Moana National Marine Conservation Strategy. A dominant and ideal discourse activated by an ex-Rugby League international player supported by the chiefdom system and the knowledge they maintained that people and nature are complementary co-habitants of the geographical home they inherited from their ancestors. The Cook Islands secured 1.9 million square kilometres as an EEZ, although it does not appear on the global circularity map. The forestry system is also subject to similar traditions of being 100 percent privately owned by the people of the Cook Islands.

2.6. Conclusion

The aim of this study was to establish a CE baseline for three remote Pacific SIDS, Samoa, Tonga, and the Cook Islands, drawing on the EMF Butterfly diagram. The results were further analysed through institutional coevolutionary analysis to elicit a comprehensive understanding of the conditions behind the efficacy or otherwise of the SIDS's sustainable policies in relation to their respective NDCs. The study found similar CE results to the findings of Andriamahefazafy and Failler (2021). In their study of nine African islands, CE principles and frameworks were implemented under different policies and regulations that prevented a holistic approach to achieving circularity. However, this article found that CE-related activities were evident across the three SIDS' sustainability strategies, although CE was not explicitly incorporated into their NDCs.

In an in-depth study of policies through institutional coevolutionary analysis, it was evident from Samoa and the Cook Islands that decentralised green energy supplies are effective, with benefits flowing directly to communities. The opposite was also evident from Tonga's sustainable energy transition, characterised by centralisation coupled with institutionalised bureaucracies. The outcomes include high investment, learning and maintenance costs, complex administrative structures, and high turnover of management personnel. The bottom line of Tonga's energy transition is characterised by rising consumer costs and recurring power disruptions.

Other policy results reveal that centralisation can be beneficial and provide just and equitable results for the population, as revealed in ocean management regimes. Once again, Samoa and the Cook Islands provided evidence through their adoption of a MPA regime. The result is an extension of the original EEZ for the benefit of their people as a whole. Tonga divided its coasts into SMA, implementing local management committees with the objective of policing their

own managed areas. This divides neighbouring communities, which are often kinships and act as support groups in difficult times and during natural disasters. While SMA committees are prima facie decentralised, the governance bureaucracy upholding them is effectively centralised.

This study concludes that when remote SIDS focus internally on cultural path dependencies such as historical values, strengths, and environmental knowledge, which have long supported the welfare and resilience of their peoples, the sustainable transition commitments reflected in their NDCs can help propel the achievement of the SDGs.

2.6.1. Limitations and suggestions for further research

This study is subject to several limitations. First, it employs a simplified method for analysing material flows. While economy-wide material flow account (EW-MFA) has been established with robust international conventions, such comprehensive analysis fell outside the scope of this study. Instead, the research focused on identifying and interpreting CE activities in conjunction with existing CE-related policies, which was sufficient for achieving the study's objectives.

Second, the study's breadth, spanning three SIDS and incorporating diverse domains such as energy, waste management, marine governance, and cultural institutions, introduces a degree of analytical complexity. While such wide-ranging coverage carries inherent risks of superficiality or interpretive failure, it also offers valuable holistic insights that would be inaccessible through narrower case studies.

These limitations point to important directions for future research. A dedicated EW-MFA could be conducted for the three Pacific SIDS as a regional cluster to generate more precise and comparative material flow metrics. In parallel, a focused longitudinal study could examine the long-term impacts and effectiveness of sustainability policies rooted in cultural and institutional path dependencies. Such research would enhance our understanding of how CE transitions are shaped over time by evolving governance dynamics, environmental pressures, and community responses.

AI Acknowledgment

The use of ChatGPT-4 for generating the equation presented in Section 2.3, and for assistance in grammar and flow editing is acknowledged.

Transition to Chapter 3

Chapter 2 aimed to achieve the first of three main objectives designed to answer the overarching question of the research. Its function was to diagnose the CE condition in the three selected SIDS by performing a stocktake using Ellen MacArthur Foundation's framework of CE concepts. The outcome provides useful insights to scaffold the next objective, which is to measure the circularity rate of the SIDS.

As the research for Objective 1 progressed, the issue of self-determination became increasingly significant, revealing a dissonance between internationally imposed solutions and the unique needs of Pacific SIDS. This realisation necessitated a shift in focus, shaping the content of Chapter 3 to explore Indigenous alternatives to the three pillars of SD.

Thus, Chapter 2 unveils the previously unknown CE conditions for Samoa, Tonga, and the Cook Islands from a global north perspective. Building on this, Chapter 3 shifts to Indigenous perspectives, beginning with an alternative three-pillar approach to SD.

CHAPTER 3

Proposed Indigenous Three Pillars of Sustainable Development

Foreword

Chapter 3, titled *Proposed Indigenous Three Pillars of Sustainable Development (SD)*, represents the culmination of conceptual developments initially presented at the DevNet Conference 2022, themed *Navigating Development in Troubled Waters*. The original title of this paper, *Enabling Tools for Development or Destructive Weapons of Self-Determination: A Comparison of Development Narratives and Nomenclature Through Indigenous Perspectives*, reflects the dominant, unresolved issue explored in Chapter 2.

As one of two "Matters Arising" chapters in this thesis, Chapter 3's role is to address a conceptual gap identified in Chapter 2 by reframing the foundations of SD through an exploratory conceptual approach (Stebbins, 2001; Swedberg, 2020). This approach is suited to early-stage theory building and the exploration of underexamined ideas with openness to new insights. It functions as a conceptual reflection and theoretical contribution, using an Indigenous lens to examine how SD narratives may undermine self-determination. In doing so, it proposes a new Indigenous three-pillar framework that redefines development narratives. This alternative framework seeks to replace the conventional economic, social, and

environmental pillars of SD with an Indigenous model that better supports self-determination and enhances resilience as an intrinsic quality.

Chapter 2 examined SD policies in Pacific small island developing states (SIDS), assessing their alignment with circular economic principles. The analysis identified both strengths and gaps in these policies, emphasising the role of Indigenous knowledge in enhancing sustainability. Findings indicated that certain policies, such as those in Samoa and the Cook Islands - successfully incorporated Indigenous practices with positive sustainability outcomes. In contrast, Tonga faced challenges, often prioritising political expediency over long-term sustainability. These insights establish a foundation for exploring Indigenous frameworks that address these challenges.

Building upon these findings, Chapter 3 reconceptualises the three pillars of SD through the lens of Indigenous values and practices. The chapter comprises an introduction, methodology, and literature review, followed by an analysis that articulates Indigenous alternatives to the conventional pillars of SD. A case study drawn from a family whose historical narrative reflects the broader genealogical connections shared by many Tongan families is presented, demonstrating how these Indigenous concepts form a cohesive and living model of sustainability.

Abstract

This study emerged from curious trends identified during a circular economy stocktake conducted in Samoa, Tonga, and the Cook Islands in 2023**.** Data analysis revealed deliberate influences by international institutions, wielding power that, in some respects, surpasses even

that of nineteenth-century colonisation in the Pacific, all under the guise of fostering a better world aligned with the ideals of *Our Common Future*.

National reports, budgets, development plans, and project documents reflect narratives heavily shaped by global summits and their implementation frameworks. Concepts such as technical blueprints, scenario-building, and futuristic modelling have become foundational methodologies guiding these policies.

In Tonga**,** the effects of these approaches increasingly mirror those of other developing nations, marked by rising crime, a widening economic gap between government officials and ordinary citizens, escalating inflation, and increasing costs of centrally supplied utilities.

This paper applies an Indigenous framework to examine the three pillars of sustainable development (SD). It introduces *Veitapui* (personal sacredness) for the social pillar**,** *Mo'unga ki he Loto* (mountain to the heart) for the economic pillar**,** and *Fonua 'a e Kakai* (land is the people) for the environmental pillar. Through these perspectives, the study explores the regressive outcomes of SD policies in Tonga**,** highlighting an Indigenous alternative that may offer an effective transformative solution to the limitations of the current SD model.

3.1. Introduction

This chapter builds upon ideas initially developed for the DevNet Conference and later refined for the Tongan Research Association (TRA) Conference, *Puke ke ma'u e fonua* (*Holding Tightly to the Land*). The TRA Conference provided a valuable forum for advancing Indigenous philosophical foundations, emphasising their rigor and legitimacy as guiding principles for development. These discussions prompted a deeper critical evaluation of

dominant development paradigms against traditional imperatives, ultimately refining an Indigenous sustainability model.

The role of this chapter is to address a conceptual gap identified in Chapter 2 by reframing the foundations of sustainable development (SD) through an exploratory conceptual approach (Stebbins, 2001; Swedberg, 2020). Such an approach is recognised for its capacity to investigate underexplored phenomena and generate theoretical insights in the early stages of inquiry. It functions as a conceptual reflection and theoretical contribution**,** providing the philosophical basis for a culturally grounded alternative to the conventional three pillars of SD.

While mainstream SD frameworks are structured around the widely accepted three pillars of social, economic, and environmental dimensions, this study presents an Indigenous alternative, one that redefines these pillars through Indigenous worldviews and priorities. The Indigenous model that emerged from this process emphasises resilience, cultural continuity, and a worldview deeply embedded in community values**.** Rather than adapting existing SD pillars, this chapter introduces a distinct Indigenous three-pillar framework, which is later developed into the I-TH model presented in the final chapter. To maintain a focused conceptual discussion**,** this chapter primarily examines the theoretical foundations of this alternative framework.

Structure of the Paper

The remainder of this chapter begins with a methodological statement. Following this, the literature review is divided into two main sections: the first explores Tongan cultural principles, which serve as the foundational epistemological lens for this study. The second section engages academic and grey literature that critically reflects on SD in the Pacific, providing cultural and contextual grounding for the Indigenous alternatives proposed in this chapter.

After the literature review, the chapter presents an in-depth exploration of Tongan alternatives to the three pillars of SD, supported by a culturally grounded historical case study that illustrates these pillars as lived and practiced knowledge.

3.2. Method

This study adopts an exploratory approach to illuminate three Tongan alternative concepts, regarded as foundational sociological, economic, and environmental principles intrinsic to Tongan society. These principles are presented collectively as a culturally grounded framework that contrasts with the mainstream three-pillar SD model. Exploratory research, as described by Stebbins (2001), is a flexible, inductive approach well suited to investigating little-known or understudied phenomena, enabling researchers to identify key variables, generate hypotheses, and uncover patterns through iterative engagement with data. Swedberg (2020) extends this view, framing exploration as a systematic yet creative process of discovery, driven by curiosity and openness to unexpected findings, and highlighting its value for early-stage theory development through methods such as abduction. This approach is therefore particularly appropriate when the goal is to build conceptual and theoretical grounding rather than to test predefined hypotheses (Tuhiwai Smith, 1999; Wilson, 2008). Within this exploratory design, a pragmatic method is used to select approaches according to their usefulness for addressing the conceptual problem and the research context (Morgan, 2007, 2014).

Earlier iterations of this chapter adopted a more comparative framing; however, the present approach uses an explorative methodology to foreground Tongan epistemologies on their own terms, rather than through juxtaposition with dominant paradigms.

As a “Matter Arising” contribution, the chapter focuses on establishing the conceptual and epistemological grounding for these Indigenous alternatives through literature-based analysis and a culturally embedded case illustration. It does not seek to test the framework empirically here; rather, it develops the theoretical foundations that will inform a subsequent critique of SD policy frameworks in Chapter 6.

In addition to conceptual exploration conducted through literature, this chapter employs a culturally grounded case study to illustrate how the selected Tongan concepts ‘Tapu’, ‘Moʻunga ki he Loto’, and ‘Fonua ‘a e Kakai’, manifest in lived experience. This approach is consistent with Indigenous methodologies that prioritise the contextual and relational nature of knowledge (Wilson, 2008; Tuhiwai Smith, 1999). The ontological position is therefore relational, recognising knowledge as constituted through relationships among people, land, culture, and practice (Martin & Mirraboopa, 2003; Tynan, 2021; Wilson, 2008).
Rather than treating the case as an empirical object of comparison, it is engaged as a site of cultural meaning-making, where ancestral knowledge, ethical codes, and place-based practices converge.

This method aligns with what Nabobo-Baba (2006) refers to as “vanua-based research,” which emphasises situated knowledge embedded in land, kinship, and practice. The case study is therefore not intended to validate the framework empirically, but to demonstrate its coherence and grounding within Tongan epistemology. By interpreting the selected case through culturally significant concepts, the analysis advances the argument that sustainability, in the Tongan context, is not a technical blueprint but an ethical system of relational practice.

The case study thus serves a dual purpose: it deepens conceptual understanding of Indigenous alternatives to the three-pillar SD model and highlights the importance of cultural analysis in theorising Pacific development futures.

3.3. Literature

As an Indigenous researcher, observations during the circular economy (CE) stocktake in three Pacific Small Island Developing States (SIDS) raised ontological, epistemological, and axiological concerns. Thaman (2019b) has raised related concerns in Pacific contexts, while Roe (1991) and Escobar (2012) critique development approaches that marginalise local knowledge and participation in shaping development. These perspectives remain largely distinct from those proposed by United Nations institutions and affiliated bodies. Furthermore, while Pacific Indigenous worldviews in academia are often explored in social science disciplines, such as public health and education, emerging environmental science research highlights their broader applicability (Fache & Pauwels, 2020; McMillen et al., 2014; Nalau et al., 2018; Nunn et al., 2024). This paper seeks to contribute to the multidisciplinary frontier of Pacific SIDS ST by building upon a corpus of literature grounded in Tongan perspectives. Notably, the widely adopted "three pillars" model of sustainability, economic, social, and environmental, is itself an emergent and politically constructed concept, rather than one rooted in deep academic theory (Purvis, Mao & Robinson, 2019). This further underscores the importance of exploring alternative models, particularly those grounded in Indigenous epistemologies and place-based ethics.

A foundational component of this perspective is Tongan history and historiography, articulated through the holistic concept of *Tala-Tukufakaholo*. Defined by Latu (2017, 48) as “storytelling as a way of the art-n-crafting, graphing and grafting of social realities on human persons, hearts,

minds, land, sea, and space, Oceanic environments of Tonga, (if not Polynesia)," *Tala-Tukufakaholo* complements conventional globalisation and development narratives. Latu further conceptualises the *Tala-Tukufakaholo* spiral as an evolving process incorporating aggregated *skyward-related* values, human rational values, and land-based practiced values as it travels through time.

The relational and ethical foundations of Tongan society are further reinforced in Taumoefolau's work on "Tongan ways of talking" (Taumoefolau, 2012), which outlines the cultural logic embedded in linguistic practices such as *lea fakahou'eiki* (way of talking to or about chiefly people), *lea fakatōkilalo/faka'aki'akimui* (self-derogatory way of talking when addressing those of higher rank), and *lea 'ita* (abusive way of talking). These speech modes do more than convey information; they uphold the ethical structure of *vā* (relational space), as theorised by Mahina (2004), guiding appropriate behaviour and reinforcing social harmony. Taumoefolau's insights affirm that Tongan concepts of balance, reciprocity, and responsibility are embedded not only in systems of governance and kinship (Runeborg, 1980, pp. 20-23), but in everyday language use - supporting this paper's proposition that SD must be rooted in cultural practice, not external policy abstractions.

Building on this epistemological foundation, this work introduces three Tongan imperatives, *Tapu/Veitapui*, *Mo'unga-ki he-loto*, and *Fonua-'a e-kakai* - as Indigenous alternatives to the three pillars of SD: social, economic, and environmental. The first of these, *Tapu* or *Veitapui*, has been translated by Herda (1987a) as "*personal sacredness*." This concept serves as an unwritten civil code that standardises key relationships within Tongan society. Kalavite (2024, pp. 640–641) further elaborates on how it fosters a sense of responsibility that results in social harmony.

The second approach, *Mo'unga-ki he-loto*, which translates to "Mountain to the Heart," reflects Tongan resilience and existential aspiration. In the absence of physical mountains in the main island of Tonga (Tongatapu), the strength and determination of the people are seen as their metaphorical mountains - representing a journey shaped by responsibility, the drive to reach beyond the seen, and faith in the unknown. It embodies an enduring spirit that enables Tongans to achieve what might otherwise seem impossible. While *Loto'i Tonga* -"the big heart" - discussed by 'Ofanoa et al. (2016), touches on emotional strength and generosity, *Mo'unga-ki he-Loto* extends further, invoking purposeful striving, anticipation, and adventure as a collective ethos. Paea et al. (2023) refer to the phrase in relation to Tongan leadership and inner strength, affirming its relevance in contemporary cultural discourse.

The third imperative, *Fonua 'a e Kakai*, meaning "Land is the People," articulates an environmental ethic rooted in lived experience, where land and human life form a single, continuous existence - genealogical, spiritual, and material. In this view, land is not external to people but an extension of their identity (Ka'ili, 2017; Mariner, 1817/ 2022), ancestry, and obligations. To care for *fonua* (land) is to care for the people; harm to one is harm to both. This ethic is immediate and actionable, in contrast to the abstraction often associated with "the environment" in global discourse, where nature is framed as something separate and distant from daily life. *Fonua 'a e Kakai* offers a relational environmental logos - tangible, culturally grounded, and deeply embedded in social practice (Herda, 1987b).

Similar ontological unity is reflected across the Pacific, where Indigenous land and marine ethics are reciprocal and sacred (Chao & Enari, 2021; Fache & Pauwels, 2020; Nalau et al.,

2018[14]). Nabobo-Baba (2006), writing on *Vanua* in Fiji, affirms that land and people are not distinct entities but one integrated being - relational, ancestral, and inseparable. This worldview, increasingly supported in Pacific scholarship (e.g., Puloka Luey et al., 2024; Vunibola et al., 2024; Salmon et al., 2023; Matapo & McFall-McCaffery, 2022; Tengan et al., 2010; Kuwanon, 2007), underscores that environmental sustainability cannot be separated from the cultural and relational spaces in which people live.

Recent regional literature supports the view that externally designed frameworks often undermine Indigenous sustainability models. Thaman (2006) critiques the exclusion of Indigenous knowledge from educational and policy arenas, advocating for a deeper embrace of cultural values within sustainability-related pedagogical discourse. Leal Filho et al. (2024) argue that the active inclusion of traditional knowledge and culturally grounded practices is essential for achieving the SDGs in SIDS, alongside integrated policy frameworks and international cooperation to address local vulnerabilities. Tadjoeddin and Vidyattama (2025) further critique the imposition of neoliberal policy models through aid conditionality in Pacific SIDS, emphasising that such strategies neglect geographic and structural realities while limiting local policy space.

Similarly, Bailey and Zou (2024) illustrate how Indigenous knowledge systems—such as storytelling, metaphor, and community-led development—can offer viable, culturally coherent pathways, cautioning against practices that treat local communities as one-time consultants in externally driven projects. Teariki and Leau (2023) reinforce this perspective, highlighting how

[14] Nalau et al. (2018) focus primarily on the role of Indigenous knowledge in ecosystem-based adaptation, but their discussion affirms the Pacific worldview where land, sea, and people are relationally and spiritually interconnected.

the marginalisation of Pacific worldviews diminishes social resilience, as imported models often carry assumptions misaligned with local realities.

Together, these studies point to a growing recognition of the need for alternative frameworks grounded in Indigenous principles. In this context, concepts such as *Tapu* and *Fonua*, which are inherently relational and culturally situated, offer potential epistemological anchors for rethinking sustainability beyond the conventional Three Pillars model.

Contested SD Paradigms in the Pacific

In addition to acknowledging epistemological gaps surrounding Pacific Indigenous worldviews, this subsection considers how SD concepts, particularly those embedded in the widely promoted three-pillar model of economic growth, environmental protection, and social inclusion, have been adopted and circulated through policy mechanisms such as the United Nations SDGs, regional trade agreements like PACER Plus, along with, more peripherally, references to the Blue Economy paradigm. While these instruments are often presented as context-neutral, a growing body of literature questions the relevance and assumptions of the development paradigms they embody when applied to Pacific SIDS (Underhill-Sem et al., 2019; Nisa, 2023; Bunkley et al., 2025). Critical theorists such as Escobar (2012) and Sachs (2015) have long argued that "development" is a culturally embedded discourse shaped by Western ideals of progress and economic rationalism. These critiques resonate within Pacific scholarship, where researchers have documented the disjuncture between externally driven development models and Indigenous priorities (Thaman, 2006; Hau'ofa, 1993). In tracing these tensions, this paper positions Indigenous concepts such as Tapu, Mo'unga-ki he-loto, and Fonua 'a e Kakai as place-based alternatives that reconceptualise sustainability as an ethical and relational practice grounded in culture.

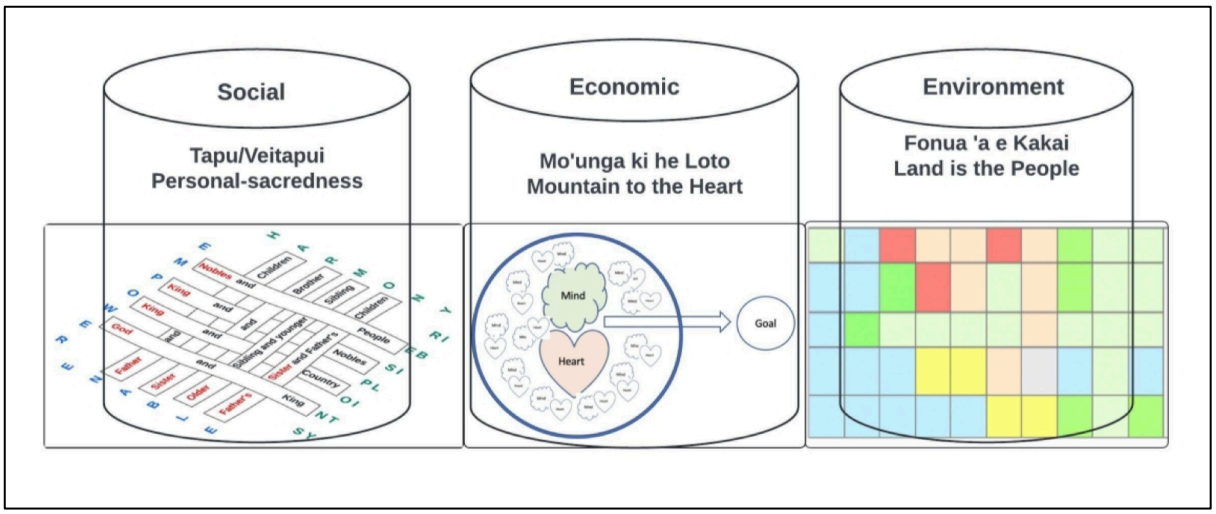
Collectively, these studies point to a growing recognition of the need for alternative frameworks grounded in Indigenous principles. In the Tongan context, concepts such as *Tapu* and *Fonua*, which are inherently relational and culturally situated, offer potential epistemological anchors for rethinking sustainability beyond the conventional Three Pillars model. This research advances a culturally rooted alternative that draws on Tongan imperatives embedded in lived practice, ethical codes, and ancestral knowledge systems.

3.4. Tongan imperatives as alternatives

Grounded in the epistemological foundations outlined earlier, this section brings forward three Tongan imperatives that offer a culturally specific and relational alternative to the dominant Three Pillars model of SD - economic, environmental, and social. These imperatives do not reinterpret sustainability through the lens of the prevailing paradigm; rather, they articulate an entirely different worldview, one embedded in Indigenous ethics, historical consciousness, and embodied social practice. Together, they constitute a coherent model of sustainability rooted in Tongan knowledge and experience, rather than abstract global constructs.

These imperatives, Tapu or Veitapui (a social approach), Mo‘unga ki he loto (an economic perspective), and Fonua ‘a e Kakai (an environmental focus), reflect a unified worldview in which sustainability is not a set of separate goals but an integrated way of life. Together, they embody a spirally ‘aggregated-skyward-related’ progression (Latu, 2017, p. 49), affirming that Tongan knowledge systems already offer enduring and viable models for achieving sustainability on their own terms. Their interconnectedness is illustrated in Figure 3.1, which visualises these imperatives as a relational and culturally grounded sustainability framework.

Figure 3.1. A Pacific SIDS alternative three pillars for sustainable development



Legend

This framework presents the integrated pillars of sustainable life (development) in Tonga, where social, economic, and environmental dimensions are woven together through sacred relational ethics.

Social – Tapu/Veitapui: *The woven relational fabric of society, where empowerment and responsibility are interlaced to strengthen individuals and communities. Tapu/Veitapui forms the foundation that enables harmony, dignity, and ethical action across all spheres of life.*

Economic – Mo‘unga-ki he-Loto: *Flowing from the strength of social relationships, this pillar reflects the inner ethical drive that guides individuals and communities toward culturally rooted goals of well-being, prosperity, and joy.*

Environment – *Fonua-‘a e-Kakai*: *Land and sea are not external resources but the living capital of the people - the embodiment of their identity, sustenance, and future. Their worth is safeguarded through cultural values; if this relational worth is diminished, land and sea risk being absorbed into externally driven forms of development (e.g., extractive capitalism).*

Source: Author

3.4.1. Tapu/Veitapui (personal sacredness) – Social Pillar

Herda (1987a) elaborates on *Tapu* (personal sacredness) as a concept intricately linked to social ranks determined by birth status. While her analysis focuses on the high status of women in Tongan society, *Tapu* extends beyond gender roles to define the apex of relationships within the culture. It establishes behavioural boundaries between entities such as sister and brother; older and younger siblings; father and children; father’s sister and father’s children; nobles and

common people; the King and nobles; the King and country; and, ultimately, God and the King. When upheld, these sacred relationships form the foundational fabric of Tongan society, reinforcing social cohesion.

In this work, *Tapu* and *Veitapui* are used interchangeably, though they reflect different dimensions of the same principle. *Tapu* emphasises the sacred boundaries inherent in social relationships, while *Veitapui* highlights the interwoven, reciprocal nature of these connections, collectively forming the fabric of relational sustainability. Together, they provide a structural framework through which responsibilities, respect, and harmony operate at every level of society.

The interactions within *Veitapui* are governed by the *Four Golden Girdles*[15]*:*

- *Faka'apa'apa* (Respect): the foundational ethic of honouring others, particularly as inherent in Tonga's stratified society;
- *Tauhi vā* (Maintaining harmonious relationships): the practice of nurturing and sustaining respectful and balanced relational spaces;
- *Loto tō* (A heart receptive to serving): an inner posture of humility and willingness to serve, grounded in self-awareness and relational responsibility;
- *Mamahi'i me'a* (Selfless commitment): an unwavering dedication to one's responsibilities, values, or loved ones, even at personal cost.

These principles bind every individual within Tongan society, ensuring that each person, regardless of social rank, has a recognised place and a valued role within the communal

[15] *Girdles* is more closely aligned with the literal translation of *Afei* which is commonly translated to *Pillars. Girdles* resembles the Biblical meaning that Apostle Paul used in Ephesians 6:14. This Tapu association with the four golden Pillars are utilised in the Tongan Conceptual Framework for the prevention and intervention in family violence in New Zealand (Tuinukuafe et al.,2012).

framework. Dignity is preserved not through individualism, but through reciprocity and mutual responsibility. Scholars such as Kaeppler (1987), Cowling (1987), Marcus (1987), and Bott (1982) have contributed to broader understandings of Tongan social organisation, often describing it as stratified. However, this stratification does not mirror Western hierarchical models. Rather than being rigid or power-centric, status in Tonga operates through relational interdependence, where every social position contributes to the collective equilibrium. As Marcus (1975) noted, referring to Aoyagi's (1966):

> My own material from fieldwork in the village of 'Uiha Ha'apai region of Tonga confirms the view that there is as much equality as hierarchy in the observed daily interactions among commoners (p. 35).

Building on this perspective, Kaeppler (1987) described her inquiry into Tongan society as an effort to uncover the structural principles that sustain it:

> I was interested in the structure that held this all together and in trying to uncover a set of principles to which the organisation and categorisation could be related. By looking at and examining surface manifestations… the underlying structures might reveal themselves. I looked for structure, by which I mean principles or mental constructs by which Tongans organise their lives (p. 66).

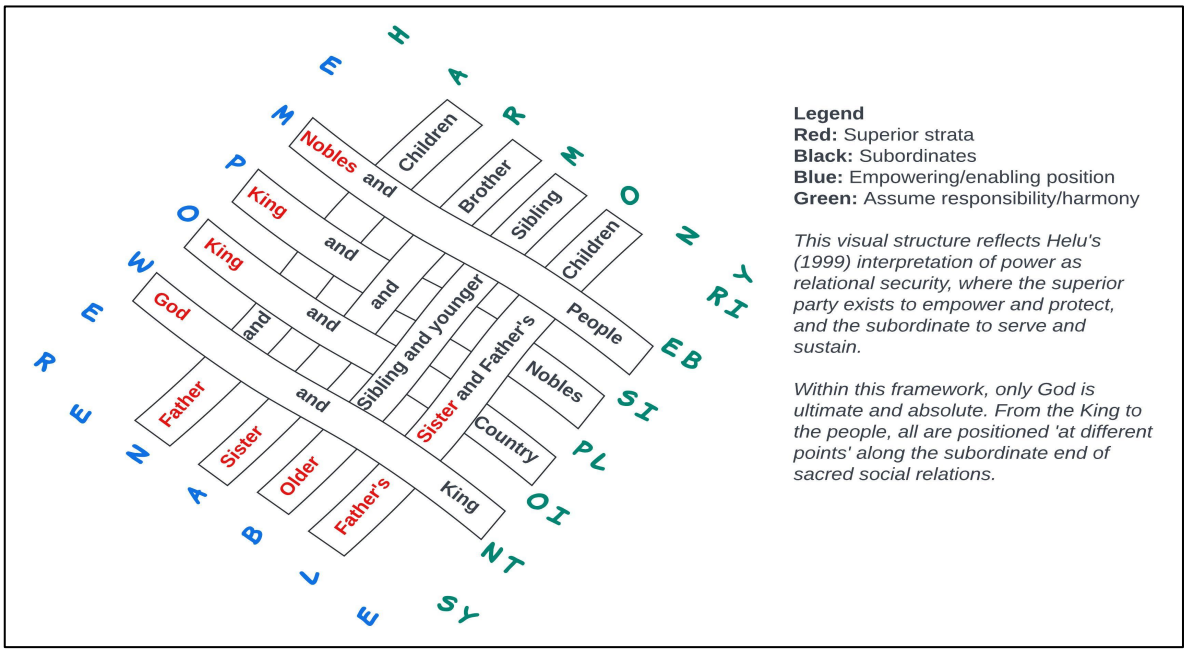
As a social approach to sustainability, *Veitapui* acknowledges the interactions among individuals, the responsibilities they owe to one another, and the honours accorded within *Tapu* boundaries. By ensuring that societal relationships remain inclusive and harmonious, *Veitapui* contributes to the resilience and cohesion of the population, an essential factor in a society characterised by limited geographical space, shared environmental challenges, and close genealogical ties. The more rigorously *Veitapui* is observed, the more stable and sustainable

the society becomes. Beyond its relevance within Tonga, this relational framework offers a model for engaging with other cultures and societies through reciprocity and respect.

Figure 3.2 illustrates the structure of *Veitapui*, depicting the hierarchical yet reciprocal relationships that define Tongan society. The model positions the superior entity in red, reflecting Helu's (1999) assertion that power among Pacific peoples is concerned with security rather than dominance (specifically the security of the subordinate party).

Within the Veitapui framework, the superior entity is not merely an authority figure but an enabler, bearing the responsibility to empower and support those beneath them in the social order (Ka'ili, 2005; Nabobo-Baba, 2006). This reflects the Tongan ethic of *tauhi vā*, in which hierarchical relationships are actively maintained through acts of protection, service and respect (Ka'ili, 2005, p. 87).

Figure 3.2. Fabric of Veitapui (Tapu relationship) in Tongan society



Source: Author

The subordinate, likewise, is not passive but actively fulfils their role in sustaining social harmony. The superior provides guidance and protection, the subordinate reciprocates through duty, service and engagement (Thaman, 2003). This distinction is vital, *Veitapui* is not a hierarchy of imposed obligations, but a relational framework in which power serves to empower, and participation sustains balance (Sanga et al., 2005).

At its pinnacle, God represents the ultimate authority, providing the laws, morality, resources and spiritual guidance that uphold the social fabric. *Veitapui*, therefore, is more than a social principle, it is a holistic governance model embedding security, empowerment, and sustainability into the foundations of Tongan society (Halapua, 2003; Vaioleti, 2011).

Incorporating a Social Pillar for Sustainability

While the social pillar of sustainability is addressed within the SDGs through initiatives such as improved education, the elimination of hunger, and the promotion of diversity and equality, the Tongan perspective diverges significantly in its foundational approach. *Veitapui* functions at the most fundamental level of societal organisation, ensuring inclusivity and mutual responsibility as core principles. In Tongan society, no one is left behind; relationships embedded within *Veitapui* secure communal well-being. Unlike external interventions that attempt to eliminate poverty and hunger through structured policies, *Veitapui* achieves these outcomes organically by prioritising relational sustainability.

At every level of Tongan society, from familial relationships to broader communal roles, *Veitapui* ensures that resources are cooperatively generated and equitably distributed, while obligations are communally upheld. Social responsibilities, such as the education of children, are not treated as isolated institutional objectives but as collective commitments deeply rooted

in cultural and genealogical ties. The principles of equity and inclusion are not imposed through formal policies but are inherent in the social structure, leading to outcomes that align with the SDGs while remaining uniquely Tongan in origin.

This paradigm functions by maintaining inclusive relationships, where every individual has a role within a network of reciprocity. Resources are shared through mutual responsibility rather than distributed through centralised systems. Well-being is measured through social harmony and relational security, rather than economic metrics. Most importantly**,** the principle of empowerment ensures that those in positions of authority enable and support those beneath them, while individuals at every level contribute to the collective well-being of society.

Veitapui, therefore, does not seek to compete with or replace existing models of sustainability but simply offers a paradigm that has sustained Tongan society for generations. However, for Tonga itself, this is not just an option – it is the only method that will ensure the survival of its people, culture, and way of life. Without *Veitapui*, Tongan society risks losing its identity, eroding its social fabric, and becoming vulnerable to external pressures that do not align with its cultural realities. In this sense, *Veitapui* is not just a model of sustainability; it is the lifeline of Tongan continuity and self-determination.

3.4.2. Mo'unga ki he Loto (Mountain to the Heart) – Economic Pillar

The concept of *Mo'unga ki he Loto* – literally "Mountain to the Heart", is rooted in Tonga's rich oral tradition. It is widely shared within Tongan oral history, particularly in reference to the leadership of Taufa'āhau (later King George Tupou I) during the 19th century civil conflicts. When the flat terrain of Tongatapu posed a strategic disadvantage in warfare, the question –

"Where is the mountain?" – was met by the response: "Tonga's mountain is in the heart." The expression symbolised the true strength resided not in the landscape, but in the internal willpower and unity of the people. Though not recorded in colonial or written historical sources, this phrase has been transmitted across generations through oral narratives, chiefly speeches and community talanoa. As Ka'ili (2017) and Thaman (2003) have shown, Tongan epistemology is deeply grounded in metaphor and orality, with expressions like *Mo'unga ki he Loto* embodying the cultural ideal of internal strength (loto) over external fortification (mo'unga). The metaphor thus functions not only as a historical reference but also a continuing cultural philosophy, affirming that resilience, leadership, and unity are cultivated from within.

From an economic perspective, this metaphor represents a deliberate alternative to the dominant Western economic paradigm. Whereas mainstream economics often centres on market exchange, private property, and the maximisation of material wealth, a process Polanyi (1944/2001) termed the "disembedding" of the economy from social relations, Mo'unga ki he Loto, as an economic concept, remains firmly embedded within Tonga's cultural, kinship, and ecological systems. It is needs-satisfying rather than needs-satisficing (Simon, 1956), meaning that economic choices are oriented toward fulfilling the communal good and preserving relational balance. Any surplus, when present, is not pursued as an economic end in itself, but is understood as a seasonal or providential outcome of nature's generosity, to be shared, honoured, and reintegrated within the circular rhythms of life, not extracted for accumulation. This stands in contrast to material-driven economic systems, where the pursuit of individual wants can push some basic needs into satisficing conditions (Sahlins, 1972/2004).

Within this system, wealth is measured not by individual accumulation but through relational wealth (Gudeman, 2001; Ka'ili, 2017), where land, labour, and resources are bound by

reciprocal obligations and a shared commitment to collective sustenance. This aligns with Hauʻofa's (1994) assertion that Pacific economies derive strength from expansive kinship networks and traditions of resource-sharing, natural safeguards, against the individualising forces of market capitalism.

This ethos was not confined to oral tradition but became embedded in Tonga's foundational economic policies. When King Tupou I modernised Tonga in the nineteenth century, he introduced a Western-style constitution, often interpreted as a move towards social emancipation. However, this framing overlooks its deeper economic intent. Confronted with the increasing push for colonisation, Tupou I visited Australia to observe first-hand what this so-called civilisation entailed (Royal Land Commission, 2012, p. 1). What he witnessed was homelessness, an alien concept in Tongan society, where kinship and shared responsibility ensured that no one was left without shelter or support (Fotu, 2012; Wolfgramm, 2024). This experience became the catalyst for his economic land policy, designed to ensure that Tongans would *never* face such vulnerability (Fakahau, 2024).

His land law guaranteed that every Tongan male aged 16 and above had the right to a town allotment (*'api kolo*) for residential use and an agricultural allotment (*'api tukuhau*) for food production (Sumeo, 2017). This was not simply a transition from a feudal system, as some commentators suggest, but an *intentional and intrinsically driven economic* strategy to safeguard self-sufficiency and prevent the structural poverty he had observed abroad (van der Grijp, 2021). Rather than mirroring Western private land ownership, Tupou I's system preserved the principle that land remained a birth right tied to responsibility, not a commodity for trade (Metuamate, 2018; Kennedy, 2012). In doing so, Tonga's foundations were secured – not only for survival, but for growth through time, rooted in stewardship and the willingness

of the heart. Each generation learns to meet its needs, strengthen relationships, and uphold the resilience of the nation, building steadily upon the knowledge and efforts of those who came before (Fotu, 2012; van der Grijp, 2021).

Mo‘unga ki he Loto thus reimagines economic life, not as the pursuit of wealth, but as the enabling of people through relational self-sufficiency. Land provides more than food or shelter – it sustains identity, nurtures cultural practices, and binds communities through acts of shared creation. In Tongan society, the needs of cultural life, mats, tapa, flowers, and food crops are fulfilled largely through what the land yields, embedding environmental care into the rhythms of social and ceremonial life.

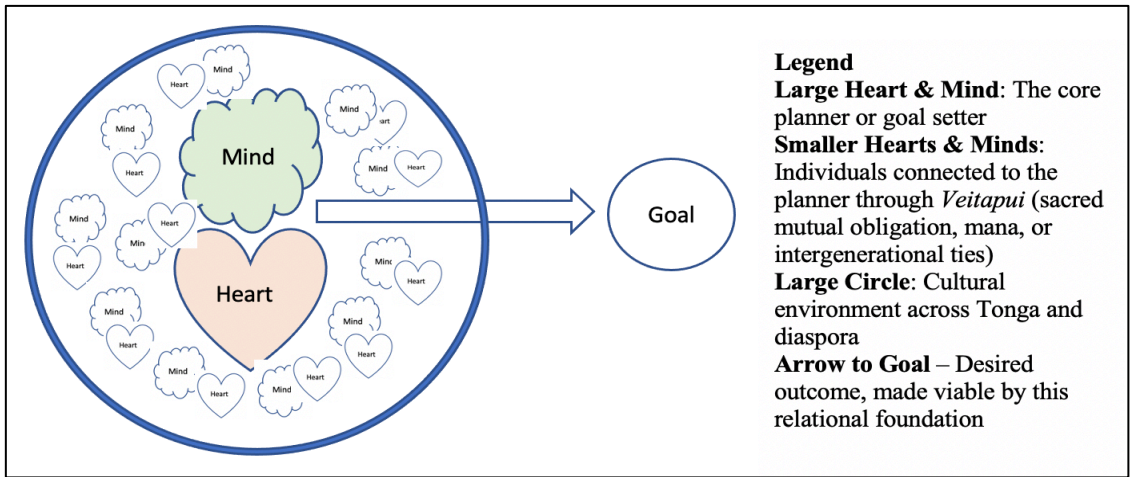
Seen through this lens, *Mo‘unga ki he Loto* naturally aligns with global efforts towards sustainability, such as the Paris Agreement and the circular economy (CE). Its focus on renewable materials, local production, and relational wealth mirrors the goals of reducing environmental harm and fostering long-term resilience. Yet it also reminds us that true sustainability is not only technical, but cultural: it is learned, practiced, and passed down through communities committed to caring for their people and their land. In this, *Mo‘unga-ki he-Loto* offers more than a policy framework; it offers a living model of how prosperity, culture, and environment can thrive together over generations.

A striking application of *Mo‘unga ki he Loto* is evident in the Tongan diaspora, where remittances comprising over 35% of the country’s GDP, serve as a vital economic lifeline. These contributions are not driven by obligation alone but by a profound sense of connection, respect, and reciprocity. They reinforce the principle that economic strength emerges not from individual wealth accumulation but from enduring communal bonds.

This ethos continues to shape local initiatives, such as the Tonga High School library (opened in 2023) and the Tonga College dormitory project (completed in 2024). These undertakings exemplify how the "mountain in the heart" translates intangible cultural values into tangible outcomes, broadening the economic sphere while preserving Tongan identity and unity. Importantly, what may appear as voluntary support is often rooted in cultural obligation. In Tonga, a planner who pledges a goal does so within a field of unspoken yet powerful relational support. Participation is frequently motivated not by personal conviction in the project itself, but by sacred ties of *Veitapui*, respect, ancestry, or past favours. This invisible ethic generates real momentum, transforming individual vision into communal action.

Figure 3.3 visualises this process, illustrating how a central vision draws strength from a surrounding network of ethical obligation. The "mountain" is not solely internal resolve, it is a manifestation of communal expectation, mana, and reciprocal responsibility. Through this dynamic, *Mo'unga ki he Loto* becomes not only a cultural philosophy but a social mechanism for mobilising shared futures.

Figure 3.3 Mo'unga ki he Loto – Mountain to the Heart



Source: Author

This conceptual illustration represents the ethical architecture behind *Mo'unga-ki he-Loto*. The large heart and mind symbolise the central planner whose vision initiates a communal or an individual goal. Surrounding them are smaller hearts and minds – individuals bound by sacred mutual ties (*Veitapui*), past favours, and ancestral obligations. While not all may agree with the goal, their relational bonds activate collective participation. The outer circle represents the planner's broader community, including diasporic networks. The arrow reflects how relational responsibility transforms internal will into outward achievement, making the "mountain in the heart" a shared force that carries the vision toward its goal.

3.4.3. Fonua 'a e Kakai (Land is the People): Environmental Pillar

Fonua 'a e Kakai (translated as "Land is the People") offers a transformative alternative to the environmental pillar of SD. In the Tongan worldview, the environment is not an external entity to be managed, extracted from, or conserved in isolation, it is an intrinsic extension of identity, culture, and survival. This concept reflects a deeply interwoven relationship between the land and its people, where the land sustains the people, and the people, in turn, care for and honour the land. Unlike conventional sustainability frameworks that position the environment as a separate dimension, *Fonua 'a e Kakai* embeds environmental stewardship into the very fabric of Tongan life, governance, and economic organisation.

A Relationship Rooted in Birth to Death

The connection between people and the land begins at birth and continues even after death. In Tongan tradition, the placenta (*fonua* - also meaning "land") is carefully buried in a chosen place, often marked by the planting of a tree. This act symbolises the new-borns' bond with the land, anchoring their identity and future to the soil. More than a ritual, it signifies an enduring

relationship of responsibility and reciprocity with the land, where identity is both physically and spiritually rooted from birth.

This identity extends beyond the immediate place of birth to the wider township and its natural landmarks. A person is not just linked to a plot of land but to the broader geography that defines their home. For instance, if Sione comes from Town-A, and Town-A has a hill, a river, and a notable rock, all these elements become part of Sione's identity. These landmarks act as symbols of belonging, just as the Māori people of Aotearoa (New Zealand) identify themselves with the mountains and rivers of their birthplaces. This demonstrates that *Fonua 'a e Kakai* is not just about land as a possession but land as an ancestral and communal identity, shaping the way individuals and entire communities understand their place in the world.

At the end of life, this relationship is reaffirmed. Tongan burial practices emphasise purity and harmony with the land, ensuring that only biodegradable materials accompany the deceased. The *fale kelekele* (house of soil) serves as the final resting place, and the belief is that the soul of the deceased cannot rest if artificial objects interfere with the natural process of returning to the earth. This spiritual reciprocity reflects the cyclical nature of life and death, where the land nurtures the people, and the people return to nurture the land. It is widely held that if non-biodegradable objects remain with the deceased, this imbalance may manifest in illness among living relatives, reinforcing the cultural obligation to prepare the body in a way that maintains natural harmony.

This intimate connection is echoed in the Tongan saying, "So-and-so wishes that they be the soil of their mother's homeland or their father's homeland." It reflects a deep longing to be

buried in ancestral soil, symbolising an eternal bond with the land that transcends physical life and continues through generations.

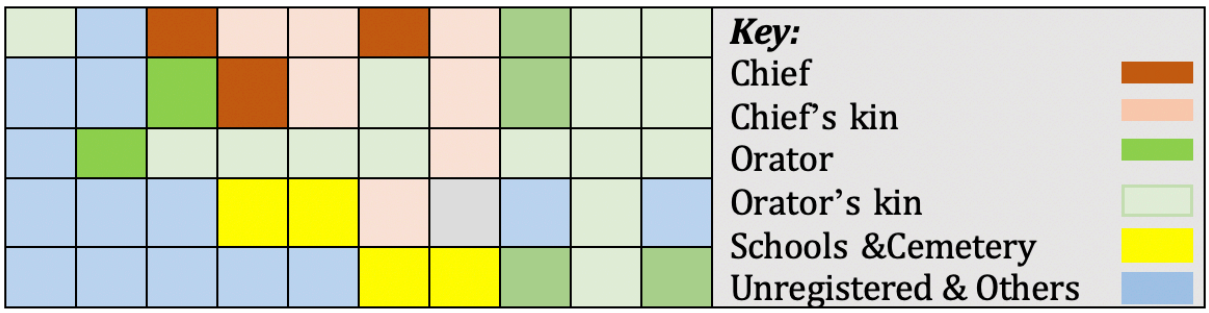
Land and Leadership: Honour Through the People

In Tonga, land is a source of dignity (mana) and identity, and this is reflected in the unique responsibilities of the nobles, known as *Nopele ma'u tofi'a* (nobles titled to land). Unlike the English peerage system, where land ownership primarily privileges individual enjoyment, Tongan nobles serve as custodians of the land, holding it in trust for their people. The Tongan saying "*Ko e Fonua 'a e Kakai*" (the land is the people) encapsulates this reciprocal relationship. A noble's status and honour are derived from their service to the people, just as the people's livelihood and identity are deeply tied to the land. Without the people to sustain a noble's position, their title becomes trivial. The proverbial statement attributed to the prestige and burdens of a chief recorded by Herda (1988, p. 106) captures this ethos.

> Your shoulders and my shoulders. If your shoulders and my shoulders are weak, we will be as slaves, but if your shoulders and my shoulders are strong, then we will be free.

The constitutional land system, as codified (James, 1995), formalises these traditional principles of stewardship, ensuring that land remains a shared resource, rooted in cultural practices that prioritise kinship and sustainability. Figure 3.4 illustrates Tonga's modern land allocation system, based on traditional appropriation practices, where land is divided among chiefs, kinship groups, and communal purposes such as schools and cemeteries. This structured system reflects the enduring principles of *Fonua 'a e Kakai*, (Thaman, 2019b; Wood Ellem, 1981, p. X) reinforcing cultural and social cohesion through the responsible distribution of land.

Figure 3.4. Tonga's modern land allocation, based on traditional land appropriation system



The figure illustrates how Tonga's modern land registry continues to reflect traditional kinship ordering. The chief's parcel anchors the settlement, with his kin adjoining him, while attendant/orators (matāpule) and their kin are positioned nearby. Land beyond this kinship cluster is designated for schools, or cemeteries, with some parcels unregistered or held outside the chiefly-kinship system.

Source: Derived from James's map of Falahola (1995:170)

The Interdependence of Land and Its Produce

Fonua 'a e Kakai extends beyond the soil to include what is grown on the land, emphasising the reciprocal responsibilities tied to agriculture and natural resources. For example, the pandanus plant, essential for Tongan crafts such as mats and cultural treasures, requires careful management. Improper treatment, such as burning green residues, can damage the plant's future growth. Traditional practices, such as drying residues before burning, or better yet, allowing them to naturally decompose, help ensure the health and sustainability of the pandanus.

Similarly, planting by the lunar calendar reflects ecological wisdom. From personal experience, elders caution against planting during a waning moon, as crops planted during this time are believed to fail. These practices demonstrate an alignment with natural cycles, ensuring that human activity harmonises with the environment's rhythms.

The Tongan calendar itself reflects this interconnectedness. Versions recorded by Collocott (1922), focused on yam phases, and contemporary interpretations explored by Paunga (2021), which integrate cosmology and seasonal rites, continue to guide agricultural social activities in Tonga. Whether marking planting seasons or communal ceremonies, the calendar integrates ecological knowledge with cultural and social imperatives, reinforcing sustainability through timing, care, and respect for nature's provisions.

An Integrated Environmental Concept

Unlike the conventional three-pillar sustainability framework - which often treats the environment as external to human activity, *Fonua-'a e-Kakai* positions the environment as inseparable from the people.

In dominant material-economic frameworks, both land and people are frequently reduced to extractive categories: Land as resource, people for labour. This reductive framing strips both their sacred value. In contrast, within *Fonua-'a e-Kakai*, the land is not a passive asset but a lifeline, a marker of identity, and a sacred trust passed intergenerationally.

This worldview reframes environmental care not as a technical or policy-driven concern, but as a deeply personal, collective, and intergenerational responsibility. Sustainability, from this perspective, is rooted in reciprocity: the land offers sustenance, identity, and cultural belonging, and in return, people maintain its vitality through practices of care and stewardship. This cyclical relationship reinforces shared responsibility, ensuring that the land remains vibrant, nourishing, and culturally intact for future generations.

Relevance to Sustainable Development

As an alternative to the environmental pillar of SD, *Fonua 'a e Kakai* challenges growth-focused and resource-extractive models that prioritise accumulative economic gains. Instead, it emphasises balance, respect, and long-term care, enabling ecological sustainability into cultural practice and daily life. This offers insights for global sustainability efforts, showing how deeply rooted values can foster harmonious relationships between people and their environment.

Dimensional Harmony in the Tongan Framework

The integration of *Fonua 'a e Kakai* (land as people), *Veitapui* (sacred mutual ties), and *Mo'unga ki he Loto* (resilient economic stewardship) reflects the profound harmony of the Tongan worldview, a harmony shaped by the islands' geographical isolation where nature itself has long been teacher, sustainer, and guide. Rather than treating social, environmental, and economic dimensions as separate categories, these pillars operate as an interwoven system of care and reciprocity. *Fonua 'a e Kakai* affirms the inseparable bond between people and land, *Veitapui* extends this principle to mutual obligations in society, and *Mo'unga ki he Loto* sustains the environment while providing for social wellbeing, thereby aligning economic life with these values. Together, these pillars ensure that sustainability is lived as a cultural and structural reality, grounded in care, equity, and interdependence across Tongan society.

3.4.4. Indigenous Three Pillars of SD demonstrated in a case study

To illustrate how the Indigenous Three Pillars of SD – *Fonua 'a e Kakai* (land is the people), *Veitapui* (sacred mutual ties), and *Mo'unga-ki he-Loto* (resilient economic stewardship) operate in practice, this account draws on the generational oral history of one family from the island of 'Eua. While grounded in a specific lineage, this account reflects broader Tongan

experiences shaped over centuries by kinship networks, land stewardship, and socio-political shifts. The example situates these imperatives in Tonga's historical reality, tracing how Indigenous frameworks adapted to internal transformations and external pressures, demonstrating their enduring relevance to modern sustainability strategies.

3.5. Case study: Tonga's alternative approach

This analysis examines traditional land allocation on the island of 'Eua as a comprehensive demonstration of Tonga's alternative approach to the three pillars of sustainability. Grounded in the Haveatu'anuku family history and corroborated by multiple historical sources, it first explores the relational dynamic between land and people (*Fonua 'a e Kakai*) as reflected in traditional land distribution practices. Drawing on insights from Gifford (185/1929, p. 178), Bott (1982, pp. 130–131) and Campbell (2006), the discussion examines how strategic marriages historically strengthened social positions and secured land access, embedding economic considerations within the broader cultural fabric rather than treating them as separate objectives.

The narrative culminates in a significant historical event that demonstrates the exercise of *Veitapui* within this framework, illustrating how social imperatives, kinship obligations, and reciprocal responsibilities shaped the trajectory of rulership and societal structure in Tonga. Through these interwoven events, Tonga's traditional approaches to social, economic, and environmental sustainability offer a holistic and enduring model for SD.

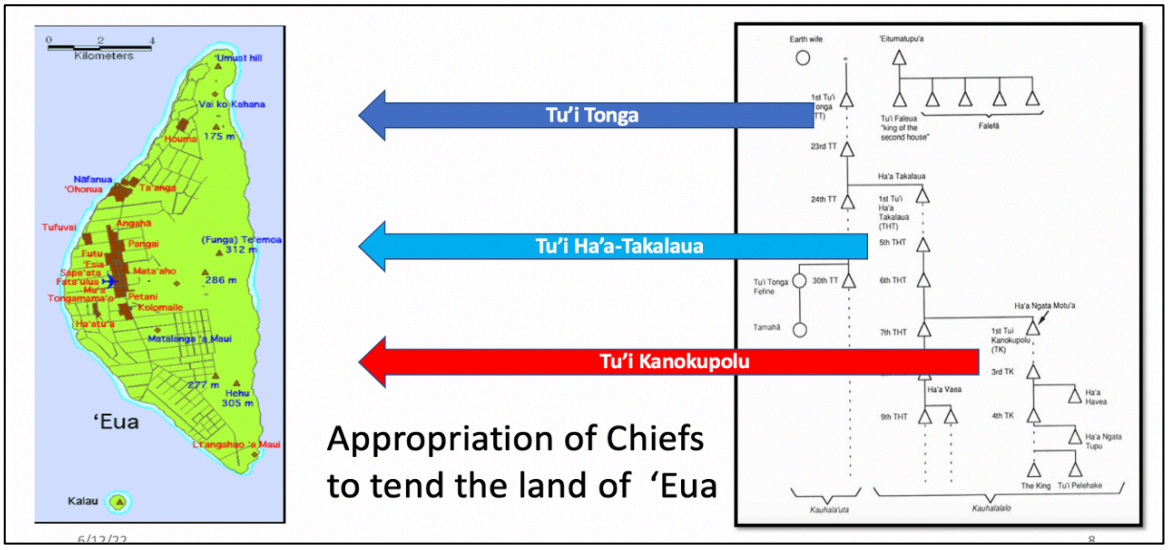
Tonga's traditional land allocation system (Marcus, 1978; Maude, 1965; Maude & Sevele, 1987) is exemplified through a snapshot of land ownership on 'Eua, beginning with Manumu'a, who was sent to the island from the court of the Tu'i Tonga in approximately the fifteenth

century. The Tuʻi Tonga, the original sacred rulers descended from the god Tangaloa's son, ʻAhoʻeitu, held the highest authority in pre-modern Tonga. Manumu'a was tasked with tending the land for the ʻInasi, the first-fruits tribute offered to the Tuʻi Tonga, while managing it for his own use and that of his kāinga (extended kin). He established his settlement in the northern part of ʻEua, marking the foundation of governance and land stewardship on the island.

Following Manumu'a, Vaka'uta was similarly appointed to oversee the southern portion of ʻEua, reinforcing the pattern of land distribution among chiefs and kinship groups. By the eighteenth century, *Haveatuʻanuku,* a younger brother of Chief Nuku from Tongatapu, arrived in ʻEua to serve as the matāpule (attendant/orator) for Tukuʻaho, the governor of ʻEua who later became the 14th Tuʻi Kanokupolu, the third and current ruling line of Tonga. Manumu'a granted Haveatuʻanuku land, further reinforcing the interconnectedness of land, kinship, and traditional governance.

Figure 3.5 contextualises these appointments of proxy chiefs and titleholders, illustrating how land tenure and governance structures evolved under the respective ruling authorities of the time.

Figure 3.5. Depiction of traditional land allocation at ‘Eua



The figure illustrates the appointment of chiefs to tend and manage land in ‘Eua across successive dynasties - Tu‘i Tonga, Tu‘i Ha‘a-Takālaua, and Tu‘i Kanokupolu. It depicts the integration of land stewardship, kinship obligations, and governance structures, highlighting the relational foundation of Tonga’s traditional approach to sustainability.

Source: Author

Gifford (1985) also noted that Manumu’a gifted a portion of his land to Hama, from the Tu‘i Ha‘a Takalaua Dynasty**,** representing the second historical line of Tongan rulers**.** This traditional land appropriation method laid the groundwork for the settlement of ‘Eua, where the lineage of chiefs and titleholders became closely intertwined**.** This historical foundation provides the context for the following sections, which explore how the Indigenous Three Pillars of Sustainability, *Fonua ‘a e Kakai*, *Veitapui*, and *Mo‘unga ki he Loto*—manifested in this evolving socio-political landscape.

3.5.1. Land is the people – environment

The genealogical connections between titleholders and landowners on ‘Eua, as recorded by Gifford (1985), highlight the deeply intertwined nature of kinship, governance, and land tenure

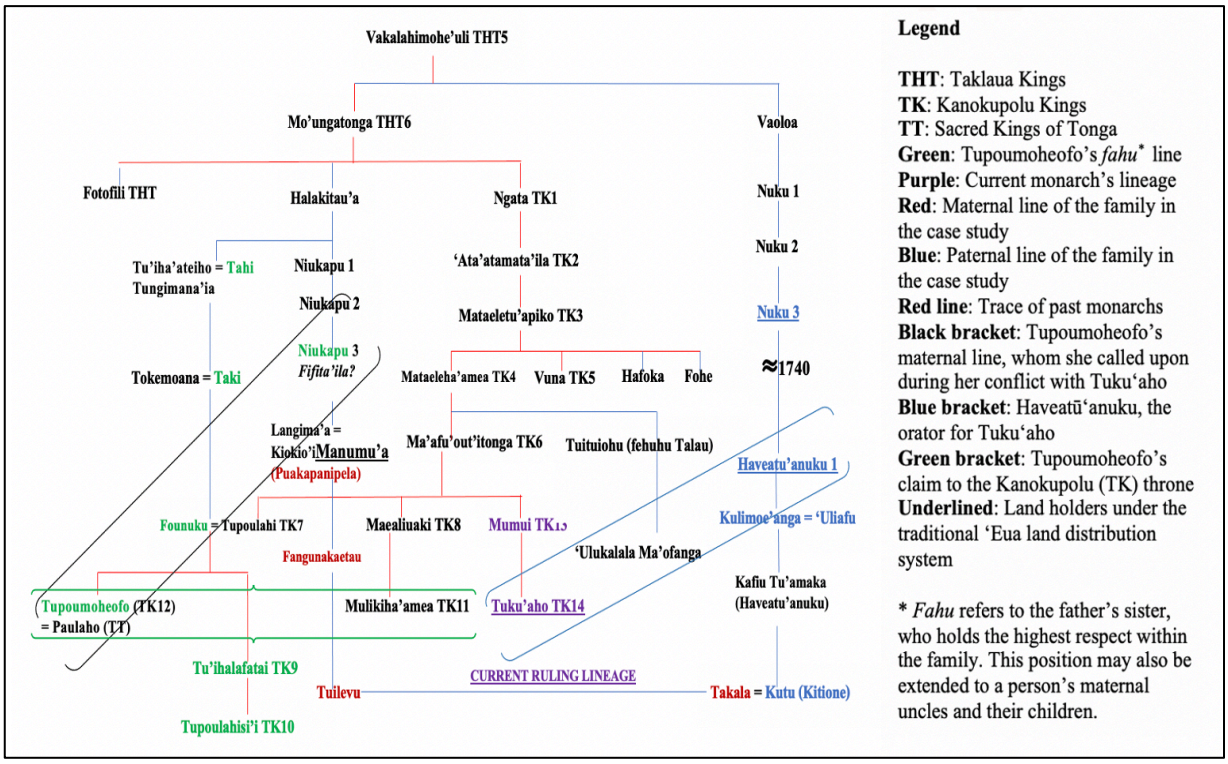
in Tonga. Demonstrating the Tongan worldview, land is not merely a physical resource but an extension of the people themselves – a sacred trust inherited across generations. This understanding closely parallels the biblical land system of Israel, where land was not to be treated as a commodity to be traded but a divine inheritance tied to covenantal responsibilities Leviticus 25:23 (New International Version, 2011). Similarly, in Tonga, the traditional land allocation system in ‘Eua, illustrates how land was shared based on responsibility rather than mere possession. Land provided not only an abode and a source of sustenance but also the means for individuals to fulfil individual needs as well as their collective obligations under their Sovereign.

Furthermore, while land remained primarily in the hands of male titleholders, strategic marriages between landholding families reinforced existing kinship ties and strengthened male lineages. This system ensured that each individual was positioned within a structured network of empowerment and responsibility, maintaining the social and economic stability of the island. Manumu‘a’s granting of land to Haveatu‘anuku reflects this principle, as it was not simply an act of redistribution but a recognition of leadership responsibility and service to the community. The relationship between land and responsibility was further exemplified through the ‘Inasi (first-fruits offering), in which the Tu‘i Tonga, despite receiving tributes, bore the responsibility of upholding cultural activities, redistributing wealth, and feeding the many people under his care. Thus, the land system’s enabling role was realised in sustaining both individual and collective well-being through reciprocal obligations.

Understanding Tongan genealogy provides insight into the social order that both contains and upholds the land. Since this case study focuses on *Haveatu‘anuku’s* genealogy, Figure 3.6 documents this lineage, illustrating how land and people serve each other within Tonga’s

Indigenous framework. This dynamic reinforces the fundamental principle that "land is the people".

Figure 3.6. Genealogies and intermarriages between chiefs and title holders of 'Eua



Source: Sione Leisi's interview (1973)[16], Bott (1982, pp. 14, 166) and Herda (1987a, p. 199).

Haveatu'anuku, descended from Vaoloa, a paternal uncle of the first Tu'i Kanokupolu and father of the first Nuku, is a brother of the fourth Nuku, although some accounts vary. Tuku'aho brought *Haveatu'anuku* to 'Eua to serve as his orator. A great-grandson of *Haveatu'anuku,* Kutu, married Takala, a granddaughter of Fangunakaetau (as recounted by Sione Leisi in 1973)[17]. The interconnected marriages among the families of Hama, Manumu'a, and Niukapu contributed to Fangunakaetau's genealogies. This form of genealogical connection to land

[16] Figure 3.6 provides a genealogical reference, based on a private family record and oral history recounted by Sione Leisi Fīnau of 'Eua (1973). This supplements the genealogies from Bott (1982, pp. 14, 166) and Herda (1987a, p. 199).

[17] Sione Leisi Finau is also a source for Latukefu regarding Hafoka's genealogy.

custodianship was not unique to land allocation on ‘Eua (Botts, 1982, p. 166). Such social arrangements provided access to resources from both land and sea, supporting both manpower and material needs and fostered a broader relational network grounded in harmonious custodianship of the environment for mutual benefit. While these social arrangements ensured access to resources and sustained environmental custodianship, they also had far-reaching implications for governance. The observance, or violation, of *Veitapui* (sacred mutual obligations) shaped Tonga’s political trajectory, as breaches in these relational structures often led to shifts in leadership and land control. This critical dynamic is further explored in the following subsection.

3.5.2. Veitapui Stronghold – Social Pillar: Its unmaking

The history of leadership within the Tuʻi Kanokupolu line provides a compelling demonstration of the *Veitapui* (sacred mutual ties) framework and its centrality to Tonga’s social cohesion and governance. Seven generations after Ngata, Maealiuaki (TK8) ascended to the Tuʻi Kanokupolu title when the seventh holder, Tupoulahi (TK7), abdicated due to old age (Bott, 1982, p. 11; Statham, 2013, p. 35). Following Maealiuaki’s tenure, leadership succession alternated among close kin, reflecting the *Veitapui*-based obligations that dictated power-sharing among siblings, cousins, and elder sibling lines.

The Role of Tupoumoheofo in Veitapui Dynamics

Within this lineage, Tupoumoheofo, daughter of Tupoulahi (TK7), emerges as a central figure, wielding considerable influence due to her position within the *Veitapui* structure. As the daughter of the eldest sibling and the wife of the Tuʻi Tonga (the Sacred King), Tupoumoheofo occupied a privileged and authoritative position. Her decision to install herself as the twelfth

Tuʻi Kanokupolu (TK12) was not merely an assertion of power but a rightful exercise of *Veitapui* obligations during a period of leadership instability.

Herda (1987a) argues that Tupoumoheofo's actions were both understandable and predictable, given her status as *fahu*, a position of authority and respect held by the sister's line, and her marriage to the Sacred King. She intervened during a perceived weakness in leadership, leveraging her Veitapui-based rights to stabilise governance. As illustrated in Figure 3.6, the line of succession had shifted from Maealiuaki (TK8) to the lineage of Tupoulahi (TK7) through Tuʻihalafatai (TK9) and Tupoulahisiʻi (TK10), before returning to Maealiuaki's line with Mulikihaʻamea (TK11). It was at this point that Tupoumoheofo, as *fahu* (father's sister to TK10 and female cousin to TK11), asserted her authority and installed herself with the support of her kinsmen.

Her self-appointment, as recorded by John Thomas and later contextualised by Herda, demonstrates the practical application of *Veitapui* principles in navigating Tonga's complex political landscape. Herda quotes another high-ranking Tongan woman, ʻAmelia (Tamahā), who described Tupoumoheofo's installation:

> [She] went to Hihifo, put a taovala [taʻovala] mat about her waist, and sat with her back to the koka tree beneath which the installation of the Tuʻi Kanokupolu took place. Then she came back and declared herself Tuʻi Kanokupolu.

Tukuʻaho's Response: Conflict and Schism

Tukuʻaho's response to Tupoumoheofo's self-installation highlights the tensions inherent in the *Veitapui* system when mutual obligations are contested or violated. Known for his strong-

willed and often ruthless character (Bott, 1982), Tuku‘aho travelled from ‘Eua, gathering chiefs along the way, and convened a meeting to install his elderly father, Mumui, as the thirteenth Tu‘i Kanokupolu (TK13). This move effectively side-lined Tupoumoheofo and introduced a period of division within the Nofo-‘a-kāinga (dwelling in kinship).

In response, Tupoumoheofo invoked her *Veitapui* rights by seeking support from her maternal uncle, Niukapu. As her first point of assistance under *Veitapui* obligations, Niukapu rose to her defense, launching a counterattack against Tuku‘aho. This moment is memorialised in the naming of Niukapu’s grandson, Fangunakaetau (“Woken to War”), commemorating the conflict and its roots in the sacred mutual ties of the *Veitapui* system.

Genealogical Context and Broader Implications

The genealogical connections between Tupoumoheofo, Tuku‘aho, and Niukapu underscore the interwoven roles of kinship, landholding, and governance in Tonga’s social pillar. Their actions reveal the fragility of *Veitapui* when its principles are violated or contested. While Tupoumoheofo’s actions reflected her rightful authority as f*ahu* and wife of the Sacred King, Tuku‘aho’s response represented a shift towards centralised authority, bypassing traditional kinship-based governance.

This schism ultimately fractured the Nofo-‘a-kāinga into two competing leadership structures, one rooted in *Veitapui* obligations and kin-based governance, and the other favouring centralised authority and political dominance. Tuku‘aho’s derisive nickname for Kiokio‘imanumu‘a (Manumu‘a), “Puakapanipela” (muddy pig), underscores the depth of these divisions and their enduring impact on Tonga’s social and political landscape.

Conclusion: Veitapui's Role in Governance and Stability

The conflict between Tupoumoheofo and Tuku'aho offers a window into the strengths and vulnerabilities of the *Veitapui* system. While *Veitapui* principles provided a framework for kinship-based governance and mutual obligations, their observance or violation could shape the trajectory of leadership and societal stability. Tupoumoheofo's intervention illustrates the power of *Veitapui* to uphold social cohesion, while Tuku'aho's actions reveal the tensions introduced by alternative approaches to authority. This dynamic interplay highlights the enduring significance of *Veitapui* in Tonga's history and its role as a cornerstone of the social pillar in the Indigenous framework of sustainability. These historical dynamics mirror modern governance tensions, where the erosion of mutual obligations and kinship-based accountability continues to challenge leadership stability and long-term sustainability. Understanding the fragility and strength of *Veitapui* offers valuable lessons for navigating today's socio-political landscape.

3.5.3. Mo'unga ki he Loto: Economic Approach in 'Eua's Land Allocation

The principles of *Mo'unga ki he Loto* were deeply embedded in how economic responsibilities were structured within Tongan society. Chiefs such as Manumu'a and Hama were not merely landholders but stewards appointed by the Tu'i Tonga and Tu'i Ha'atakalaua dynasties to oversee economic production and resource distribution in alignment with kinship obligations. Unlike in England, where land was often a reward or a symbol of hierarchical power, in Tonga, land was an extension of the people themselves. It was entrusted not for personal enrichment but for cultivation, sustainability, and the collective advancement of kinship networks.

Land was not treated as a fixed and personal asset enhancing individual power, but as a fluid and dynamic resource, made available to those able to steward it responsibly. If land lay idle,

it was not preserved as untouchable private property but reallocated to ensure active cultivation, reinforcing the principle that its use must serve the broader community.

Rooted in the Pacific SIDS worldview, this relational economic approach does not distinguish survival from aspiration. A thriving society secures essential needs while cultivating higher ambitions – expressed through diplomacy, navigation, craftsmanship, or knowledge. This ethos underpinned Tonga's long-distance oceanic voyages, inter-island trade, and the development of sophisticated maritime technologies, enabling the forging of tools, construction of canoes, and regional influence through negotiation, alliances, and, when necessary, warfare. In this economy, formidable challenges were catalysts for innovation—capturing the spirit of *Moʻunga ki he Loto*, where "where there is a *purpose*, there is a way."

This worldview shaped not only general land stewardship across Tonga but also specific family histories. A relational understanding of economic activity, rooted in duty, loyalty, and collective advancement, is further illustrated through family oral histories, extending beyond the maternal line connected to Tupoumoheofo. One such account tells of *Haveatuʻanuku's* son, who exemplified *Moʻunga-ki-he-Loto* through his courageous defense of ʻUlukālala Maʻufanga during a time of conflict. This story captures the same Indigenous ethos where economic activity – land acquisition, social standing, and security was deeply tied to acts of service, resilience, and purposeful striving on behalf of the collective. Quoted directly from Leisi's account in 1973:

> ʻEua. Kulīmoeʻanga lived at the time when Vavaʻu opposed ʻUlukālala Maʻufanga, son of Tuituiohu, who is the son of Mataele Haʻamea, who is the son of King Kanokupolu. The people of Vavaʻu went and took Feletoa, and ʻUlukālala went to live at Neiafu. A message got to Tongatapu, and the King sent a message to Hehu,

> a fort built by ʻAtaʻatamanuetoafa, son of Veʻehala. The army went against the people of Vavaʻu.
>
> Kulīmoeʻanga heard about the war at Vavaʻu. He asked how many men were going; they said about 40 men. Kulīmoeʻanga said, "Only one can do it. I will go to Vavaʻu and I will fight them." Kulīmoeʻanga went with his chosen partner named ʻOhonua. They fought and won. ʻUlukālala went back to his place. ʻUlukālala asked Kulīmoeʻanga how he would reward him with land or treasures. Kulīmoeʻanga said that he would take a piece of land at Tuʻanuku and live there so he could continue his duty to the King. So Kulīmoeʻanga lived at Tuʻanuku, naming it after his place at ʻEua. The partner of Kulīmoeʻanga, ʻOhonua, also got his land at ʻOhonua at Leimātuʻa, named after ʻOhonua at ʻEua. (Leisi, S. 1973).

This account highlights the centrality of service, loyalty, and purposeful striving (*Moʻunga ki he Loto*) as foundations of landholding and social security in Tongan economic life. Early European observations and more recent scholarship confirm this economic ethic, highlighting the communal productivity, resource stewardship, and relational values embedded in Tongan society (Huffer & Rakuita, 2008, p. 13).

Shared Labour and Collective Productivity

Captain Cook's visit to ʻEua provides an early European observation of this system. Hosted by Hama, he witnessed first-hand the communal nature of land stewardship and the role of chiefs in ensuring the well-being of their people. Cook remarked on the abundance of food, the structured plantations, and the hospitality extended to visitors, all reflections of an economic model grounded in collective sufficiency rather than individual accumulation:

> I thought I was transported into one of the most fertile plains in Europe… The Island of Tonga-tapu and the skirts of Ea-oo-we [‘Eua] are as I have before observed wholly laid out in Plantations in which are some of the richest Productions of Nature (Botts, 1982, p. 15).

This cooperative approach ensured food security, minimised economic risk, and reinforced kinship ties, making Tonga’s economic system inherently resilient. Labour was valued not in monetary terms but by its contribution to social cohesion and collective well-being.

Resource Redistribution

Economic stability relied on distribution and sufficiency. Surpluses were shared among kin and dependents or used for community projects and ceremonial obligations, ensuring that no one was left without access to essential provisions. This redistribution reflected a deeply embedded ethic of reciprocity, which aligned economic activity with the principles of *Veitapui* (Sacred Mutual Ties) and *Fonua ‘a e Kakai* (Land as the People). Chiefs played a key role in ensuring that resources were circulated rather than hoarded, reinforcing social cohesion and economic balance.

A Non-Material Worldview of Economic Resources

The Pacific SIDS worldview fundamentally challenges the materialistic and individualistic notions of wealth prevalent in Western economic models. This contrast is particularly poignant in the historic conversation between William Mariner and Finau[18], as recorded by Martin (1817). Upon learning about money, Finau reflected:

[18] Finau was the son of ‘Ulukālala Ma‘ufanga, whom Kulīmoe‘anga assisted. Although Mariner’s experience took place at a later period in the Ha‘apai Islands - regarded as remote by today’s economically driven standard, Tonga’s pre-modern society maintained strong relational ties across islands, driven not by individual

> If money were made of iron and could be converted into knives, axes and chisels there would be some sense in placing a value on it; but as it is, I see none. If a man has more yams than he wants, let him exchange some of them away for pork or ngatu [tapa cloth]… Certainly money is much handier and more convenient but then, as it will not spoil by being kept, people will store it up instead of sharing it out as a chief ought to do, and thus become selfish… (Martin, 1817, pp. 75-80).

Finau's perspective reveals an economic approach deeply embedded in relational ethics and sustainability. Unlike money, provisions are inherently perishable, fostering a culture of sharing and reciprocity rather than hoarding and individualism. This aligns seamlessly with *Mo'unga ki he Loto*, where the goal of economic activity is not accumulation but sufficiency and relational fulfilment.

Lessons for Modern Economic Systems.

Mo'unga ki he Loto is not merely a historical model, it offers enduring lessons for modern economic systems:

- *Balancing Tradition with Modernity:* While remittances and global markets now shape Tonga's economy, embedding *Mo'unga ki he Loto* principles in modern policy ensures that economic prosperity aligns with social and environmental well-being rather than undermining them.
- *Reimagining Wealth:* Finau's rejection of money as a stored resource presents a counter-narrative to contemporary economic models that prioritise hoarding and capital

economic empowerment but by collective obligations and inner strength (Mo'unga-ki he-Loto). One must read the history of pre-modern Tonga as a community of kinship without geographical limitations.

accumulation. *Mo‘unga ki he Loto* offers an alternative perspective, where economies are designed around reciprocity and sufficiency rather than scarcity and excess.

- *Sufficiency Over Accumulation:* The Western economic model prioritises profit and expansion, often at the cost of environmental degradation and inequality. *Mo‘unga ki he Loto* challenges this paradigm, defining economic success not by wealth accumulation, but by the ability to meet human needs, sustain relationships, and maintain resilience.

Economic Sustainability Through Mo‘unga ki he Loto

The economic practices on ‘Eua, shaped by *Mo‘unga ki he Loto*, reveal a deeply relational and sustainable approach to meeting human needs. This model did not function in isolation but was embedded within the broader frameworks of *Fonua ‘a e Kakai* (Land is the People) and *Veitapui* (Sacred Mutual Ties), ensuring that economic, environmental, and social sustainability were not separate but mutually reinforcing.

By prioritising sufficiency over accumulation, reciprocity over competition, and long-term resilience over short-term gain, *Mo‘unga ki he Loto* offers a holistic vision of sustainability. It provides a roadmap for modern economic thought, demonstrating that prosperity is not measured by wealth alone, but by the well-being of people, the health of the environment, and the strength of relationships.

3.5.4. Conclusion

These findings contribute directly to the overarching thesis question regarding how Indigenous knowledge can inform SD in Pacific SIDS by examining traditional Tongan understandings of the three pillars of SD. These pillars, *Veitapui* (social), *Mo‘unga ki he Loto* (economic), and

Fonua ʻa e Kakai (environmental), form a culturally embedded framework that address critical sustainability imperatives in ways deeply resonant with Tongan worldviews. This Indigenous model prioritise relational harmony, collective resilience, and environmental stewardship, offering a cohesive and enduring alternative to Western market-driven approaches characterised by individualism and extractive logic.

In contrast to conventional sustainability models that treat environmental, economic, and social policies as separate, the Tongan worldview sees them as inseparable dimensions of a unified system. This study reaffirms that land is not merely a resource to be managed, but an inseparable extension of the people. The well-being of the people sustains the land, just as the vitality of the land sustains the people.

Fonua ʻa e Kakai embodies this inseparable link between people and land, where land allocation is governed not by ownership but by stewardship and kinship obligations. The land does not simply sustain life; it is an active agent in the continuity of kinship, governance, and resource distribution.

Veitapui, in turn, is upheld by the land system, where kinship and sacred obligations shape how land is managed and shared. This land system ensures that no individual exists outside of relational ties, reinforcing the principle that sustainability is not just about environmental care, but about the continuation of kinship responsibilities that govern social cohesion.

Moʻunga ki he Loto animates this system by ensuring that economic activity remains inseparable from kinship and land. It is relationally driven, purposefully distributed, and

oriented towards collective benefits. This ensures that wealth is measured not in terms of accumulation, but in the well-being of the community and the resilience of social ties.

Together, these three pillars form a cohesive and living model of sustainability. They do not function in isolation, but as a living system where sustainability is embedded in cultural responsibilities, reciprocity, and enduring bonds between people and the land. Through this integration of relational values, collective action, and environmental care, Tonga addresses contemporary sustainability challenges in ways that honour their heritage and build a resilient future.

As the case study illustrates, Tongan history - expressed through family genealogies and national narratives - serves as a triangulation mechanism that validates the universality of these Indigenous pillars. These shared histories reflect a worldview in which sustainability is not a policy directive but a way of life: intergenerational, culturally grounded, enduring, and to be established and promoted through the education system.

The ‘Eua case study affirms this conceptual model, demonstrating how these Indigenous pillars have long functioned as an integrated system, not only guiding historical governance and resource management, but also offering valuable insights for contemporary sustainability planning.

Transition to Chapter 4

Chapter 3 created a dedicated space to explore critical themes that emerged beyond the first objective outlined in Chapter 2. As a “Matters Arising” contribution, it responded to conceptual

gaps by foregrounding Indigenous epistemologies and examining the limitations of externally driven CE policies. These models, often applied in unadapted, foreign forms, have struggled to deliver meaningful outcomes in Pacific contexts. In response, the chapter presented culturally grounded Tongan concepts of progress as essential alternatives to prevailing SD strategies.

Building on this foundation, Chapter 4 now advances the thesis's second objective: to measure the circularity rate within Pacific SIDS using the Economy-Wide Material Flow Analysis (EW-MFA) methodology. This quantitative study not only calculates the nation's circularity rate but also provides insights into its socioeconomic metabolism. The EW-MFA serves as a valuable analytical tool, yielding objective results that can inform more contextually relevant and data-driven policy decisions.

Thus, Objective 1 has been addressed through both critical reflection and Indigenous theory-building. Chapter 4's quantitative analysis complements these insights by deepening our understanding of sustainability tools while continuing to centre self-determination in the pursuit of more appropriate development pathways for Pacific SIDS.

CHAPTER 4

An EW-MFA of a remote Pacific SIDS

Foreword

In Chapter 4, the material flow within a Pacific SIDS is systematically examined, tracking all materials entering the country from external economies and the environment. The analysis follows these materials through their domestic use, export, or accumulation within the country. This data enables a deeper understanding of the country's socioeconomic metabolism, offering insights into its material and energy use patterns.

This chapter fulfils the second objective of the thesis, building naturally upon the first objective addressed in Chapter 2 which took stock of CE activities and performed a governance coevolutionary analysis, which raised issues around self-determination in relation to externally imposed CE policies. Chapter 3 explored these self-determination concerns in depth. This chapter continues this analytical focus by quantifying material flows, providing an empirical basis to further inform SD strategies.

The chapter is organised into four sections: Introduction, Methods, Results, and Discussion. The Introduction includes a literature review, situating the study within the relevant scientific discourse and articulating its aim and contribution. The Methods section details the technical aspects of the EW-MFA, followed by the Results and a Discussion, which explores policy implications and directions for future research.

By quantifying both material and energy use, Chapter 4 provides a significant contribution to sustainable transition policy tools for Pacific SIDS, offering a clear, objective measure of the nation's socioeconomic metabolism.

Journal paper 2:

An economy-wide material flow analysis of a remote Pacific SIDS: How circular is it?

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Multiple authors' statement

Litia Vea-Simpson collected and processed the data and is the primary author.

Professor Matthew Roskruge directed, supervised and reviewed the manuscript.

AI Acknowledgment

ChatGPT4 was used to polish writing and enhance clarity, all research ideas, methodologies, and substantive content are the original work of the researchers.

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Abstract

The S.A.M.O.A. Pathway (2014) outlines priority areas to support sustainable development in Pacific SIDS. While Tonga has aligned its policies with international guidelines, it lacks circularity metrics that could directly inform socioeconomic and environmental indicators for advancing its Nationally Determined Contributions (NDC). This study aims to quantify Tonga's circularity rate and present its socioeconomic metabolic profile to identify opportunities for mitigating the nation's sustainability challenges. Employing EW-MFA, the study integrates data from the UN International Resource Panel with national economic statistics, complemented by heuristic insights, to deliver the first comprehensive material flow analysis for Tonga. The results reveal a high dependency on imported biomass energy and consumption products, contributing to a substantial volume of biomass End-of-Life (EoL) waste. Material wastes are not recycled, but exported, leading to a computed circularity rate of zero for Tonga. These findings highlight the untapped potential of biomass waste to improve energy independence and sustainability. Policy recommendations include strategies to address inefficiencies in material use, reduce import dependency, and foster a CE approach, ultimately challenging the linear trajectory of current consumption behaviours.

Keywords: Circular Economy, Industrial Ecology, Circularity Metrics, Socioeconomic Metabolism, Resource Circularity in SIDS, Biomass Valorisation, Sustainable Development in Pacific SIDS

Informed Consent

The authors have obtained informed consent from all participants.

Conflict of Interest

The authors declare that there is no conflict of interest.

AI Acknowledgment

ChatGPT4 was used to polish writing and enhance clarity. All research ideas, methodologies, and substantive content are the original work of the researchers.

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Introduction

This paper builds on a comprehensive review of circular economic (CE) strategies and activities conducted in three Pacific SIDS. The study reveals that current import practices and resultant waste management policies pose significant environmental challenges for the populations of these SIDS (Vea-Simpson, 2024). As industrial nations strive to meet sustainability and climate targets, they have increasingly adopted CE regimes and implemented concomitant policies (Winans et al., 2017, p. 2; McDowall et al., 2017, p. 2). The next critical step in this progression is the development of tools to effectively measure the success of these CE activities. EW-MFA provides key indicators that inform policy directions, establish baseline markers, and track measurable progress (Haas et al., 2015; Mayer et al., 2019; Aguilar-Hernandez et al., 2018).

Fundamentally, EW-MFA is a systematic assessment tool that quantifies the flows and stocks of materials within an economy as well as the transfer of materials to and from the environment

and other economies (Eurostat, 2001, p. 11; Bringezu et al., 2003, p. 43; Kovanda, 2014, p. 78). Its utility has become increasingly recognised, making it particularly valuable for measuring the circularity rate and related indicators of economies (Flanders, 2021; Pauliuk & Hertwitch, 2015; Islam & Huda, 2019; Delahaye, 2022; Von Blottnitz et al., 2022).

EW-MFA has a comprehensive history leading to the methodological consensus outlined in the *Economy-wide Material Flow Accounts Handbook* (Eurostat, 2018) with foundational contributions by Fischer-Kowalski et al. (2011), Ayres (1997), Ayres & Simonis (1994), Krausmann et al. (2015), Bringezu et al. (2003), Haberl et al. (2004), and Haas et al. (2015), among others. Early application is reported by Krausmann et al. (2015, p. 8) thus:

> Since the first economy-wide MFA and balances for Austria (Steurer, 1992) and Japan (Environmental Protection Agency 1992) many researchers and statisticians have used similar approaches. Within the EU, economy-wide MFA are now available for Denmark, Germany, Italy, the Netherlands, Austria, Finland, Sweden and the United Kingdom.

The EW-MFA incorporates national economic data that has been statistically demonstrated to achieve an acceptable level of maturity for its intended purpose (Kowalski, 1998). As modelling and analytical techniques evolve (Mayer et al., 2019; Aguilar-Hernandez et al., 2018; Haas, 2020; Wiedenhofer et al., 2019), improvements in data quality and availability are facilitated (Eurostat, 2001).

4.1. Aim and contribution

The aim of this study was to perform an EW-MFA for Tonga, a remote SIDS, for the year 2022. This analysis seeks to examine the *socioeconomic metabolic* conditions of the locality,

providing essential insights for operational and contextual evaluations to inform climate change mitigation strategies and policy development (Wiedmann et al., 2023). Juxtaposed with industrial nations, vulnerable Pacific SIDS (less than 3,000 km^2) do not engage, apart from Nauru (Pollock, 2014)[20], in the extraction of non-renewable resources; instead, they are highly dependent on imports (World Bank Group, 2022)[21], particularly since globalisation became central to progress and development in the twentieth century (IMF, 2000). Using Mayer et al.'s (2019) EW-MFA framework, this study extends the literature with a focus on Pacific SIDS.

To achieve this aim, the following outcomes were pursued: i) identify the volume and dynamics of material throughput for Tonga, ii) establish the circularity rate, and iii) present the socioeconomic metabolism profile of Tonga in Sankey visualisation and interpret its implications for current and future policy directions. This study is the first to conduct an EW-MFA in the Pacific SIDS region. Krausmann et al. (2015), del Campo et al. (2023), and Noll et al. (2021) conducted state-of-the-art material flow studies on developed SIDS, focusing on Iceland and Trinidad and Tobago, the Bahamas, and Samothraki, respectively. These studies reveal shared considerations, such as the critical role of geomorphological characteristics in addressing sustainability challenges (Noll et al., 2021). However, the resource-rich endowments and continental proximity of these developed SIDS, which support their developed status, underscore a significant epistemological gap in the context of Pacific SIDS. This gap highlights the urgent need for targeted research to address the region's unique sustainability dynamics.

[20] Nauru did engage in phosphate mining from 1906 to as recently as 2006 albeit to a limited degree.
[21] World Bank data: Imports of goods and services for Tonga in 2021 was 60.8% of GDP while Pacific nations as a whole recorded 65.7% of GDP.

Pariatamby and Tanaka (2014) researched similar themes in the Pacific, but fell short of conducting an EW-MFA. Chioatto et al. (2024) offered a contextual landscape for the current state of EW-MFA methodology in the scientific literature, providing a convenient dichotomy between 18 methodology papers and 50 application studies. The study at hand aligns with the latter group. Focusing on studies with closer climatic and cultural relevance to Pacific SIDS, from Chioatto et al., two studies from Vietnam and Malaysia further illustrated the Asian applications of EW-MFA.

Similarly, Huong et al. (2021) applied a decomposition analysis in Vietnam using the Impact, Population, Affluence, and Technology (IPAT) framework to trace material flows. This comprehensive study, spanning four decades, details the complex interactions within a country's economic metabolism, albeit the findings are too intricate to apply directly to the Pacific SIDS environment due to systemic differences. Conversely, Frame et al. (2022) focused on utilising EW-MFA in Malaysia to explore the interplay between economic growth and environmental trajectories over time, assessing potential contradictions. These two studies provide relevant insights into the application of EW-MFA for Pacific SIDS research.

Two further studies included in Chioatto et al. (2024) from Africa are of interest in this pursuit. The first, by Hoekman and von Blottnitz (2017) focused on Cape Town's metropolitan municipality in South Africa, revealing the significant domestic extraction of non-metallic minerals, with imports primarily comprising biomass and fossil fuels. This study underscores the need for further investigation to fully comprehend the municipality's metabolism. It is inferred that caution should be exercised against a generalised approach to EW-MFA, which could lead to inevitable policy failure. Second, Frame (2016) analysed the impact of economic integration from 1970 to 2011 on Tanzania's socioeconomic metabolism. Despite prolonged

efforts towards economic growth, Tanzania remains economically peripheral, pointing to the critical need to tailor policies to local conditions.

The final study from Chioatto et al.'s (2024) compendium of papers, was conducted by Giljum et al. (2014). They examined global material flows and trade from 1980 to 2009. Their findings show a 94% increase in the global extraction of natural resources over three decades. This underscores the growing global consumption context necessitating EW-MFA. The reviewed studies revealed a critical gap in the application of EW-MFA in the Pacific SIDS - an analysis that unveils socioeconomic metabolic conditions, beyond the conventional economic indicators.

4.2. Background

The outline below briefly traces Pacific SIDS' sustainable transition (ST) efforts, their environmental-economic accountability status, and their need for an EW-MFA study. Pacific SIDS were at the forefront of making concrete pledges through the *SIDS Accelerated Modalities of Action (SAMOA Pathway)* following the Paris Agreement (UN General Assembly, 2014)[22]. From 2015 to 2017, the *Economic and Social Commission for Asia and the Pacific (UN ESCAP, 2017)* **c**onducted a *System of Environmental-Economic Accounting (SEEA)* implementation exercises for four Pacific SIDS: Micronesia (FSM), Fiji, Palau, and Samoa. Additionally, five Pacific nations - FSM, Fiji, Palau, Samoa, and Vanuatu, were evaluated for their readiness to implement this system. Further awareness training was conducted across the Pacific Islands. An assessment of the SAMOA Pathway, prepared for the

[22] SAMOA Pathway approaches its end in 2024 when it will assess SIDS's ability to meet the 2030 Agenda and SDGs

Tonga Preparatory Meeting (Basu & Trivedy, 2023, p. 20), identified significant data gaps, indicating insufficient relative data availability in SIDS.

Additionally, in 2023, an assessment by the UN Statistics Division (2023)[23] indicated progress in Fiji and Samoa in environmental-economic accounting, while Palau, Vanuatu, and Tonga had yet to move beyond the intention to implement these practices. In contrast, a recent review of CE strategies and activities in three Pacific SIDS, including Tonga (Vea-Simpson, 2024), found that CE activities are underway. However, similar to findings from African SIDS (Andriamahefazafy & Failler, 2021) fragmented implementation due to policy oversight makes CE endeavours susceptible to failure. This study infers that the use of EW-MFA provides a useful systemic tool that offers comprehensive and objective support for sustainable development (SD) policy initiatives. Furthermore, the data insufficiency highlighted above underscores the importance of this research in contextualising concepts and directing attention to critical data needs.

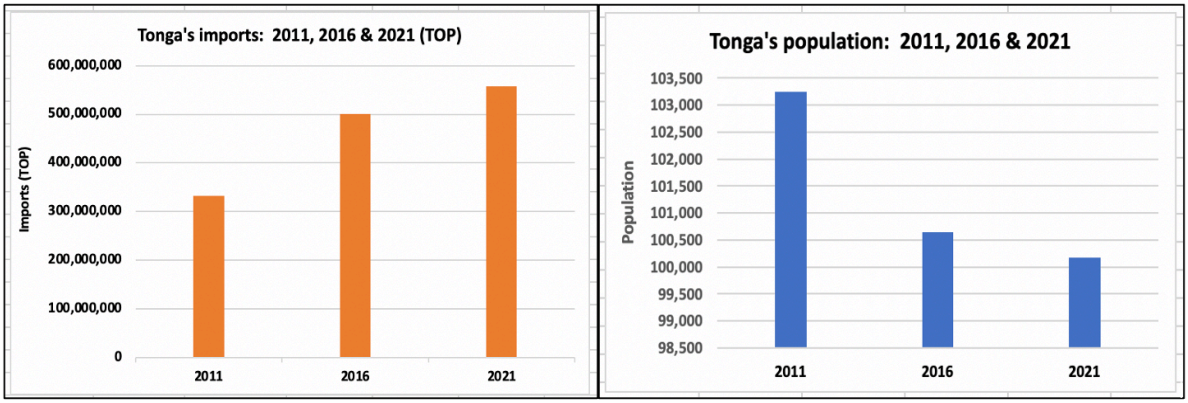
4.2.1. Tonga's Socioeconomic context

Tonga comprises a relatively dispersed group of islands and is the fourth largest nation in Polynesia, with a population of 100,179 (2024)[24] and a total land area of 747km^2. The nation has an estimated GDP of USD 451 million, yielding a GDP per capita of USD 4,730[25]. Imports account for 60.8% of GDP, while exports represent 12.5% (Government of Tonga[26]; Worldometre online statistics, n.d.; Macrotrends, n.d.)[27]. Figure 4.1 illustrates Tonga's import statistics for 2011, 2016, and 2021, showing an increasing propensity to import, intensified by

[23] Specific page where this information is published: https://seea.un.org/content/2023-global-assessment-results
[24] Latest Tonga Government Statistics dashboard.
[25] Xe converter at the day of writing
[26] Government of Tonga Statistics: https://tongastats.gov.to/statistics/economics/national-accounts/
[27] Figures acquired under Creative Common license
Macrotrends: https://www.macrotrends.net/global-metrics/countries/TON/tonga/exports

a downward trend in Tonga's population statistics for the same years. The most recent national waste audit calculated that each person produces 90.52 kg of waste per year (SPREP, 2023), a figure that could worsen given the inverse trends evident.

Figure 4.1. Tonga's National trade and census snapshot: 2011, 2016 & 2021



***Note**:* Constructed from Tonga's IMTS (2021)[28] and Population Statistics[29]

Building on Tonga's socioeconomic context, the ongoing trajectory towards SD raises questions about the adequacy of purely economic approaches in addressing broader societal well-being. This invites consideration of alternative perspectives, particularly those rooted in cultural values, which emphasise quality of life and security as integral to SD.

The notion that "subsistence wealth values the quality of life instead of the quantity of financial accumulation" (Hosman, 2019) is central to many Pacific cultures. Taufe'ulungaki, in Fusitu'a et al., (2023), elaborated on this concept from a Tongan standpoint, promoting "Koloa" (endowments), which include assets not typically evaluated in monetary terms. Additionally, Helu (1999), in an attempt to describe Pacific cultures, highlighted their homogeneity and continuity despite largely oral historical records prior to European arrival. Helu proposed that

[28] https://tongastats.gov.to/statistics/economics/foreign-trade/#75-238-2021-overseas-trade
[29] https://tongastats.gov.to/statistics/population-statistics/

in examining the distant past to uncover strategies for gaining and retaining power, one would find that "power has no other value but its capacity for delivering security."

Given the above socioeconomic and historical context, the remainder of this paper is structured as follows: Section 2 outlines the method utilised in the proposed EW-MFA for Tonga, concluding with a discussion on methodological quality and limitations. Section 3 details the findings, while Section 4 presents the discussion. Finally, Section 5 offers conclusions, with a focus on actionable policy implications in Section 5.1 and potential avenues for future research in Section 5.2.

4.3. Method

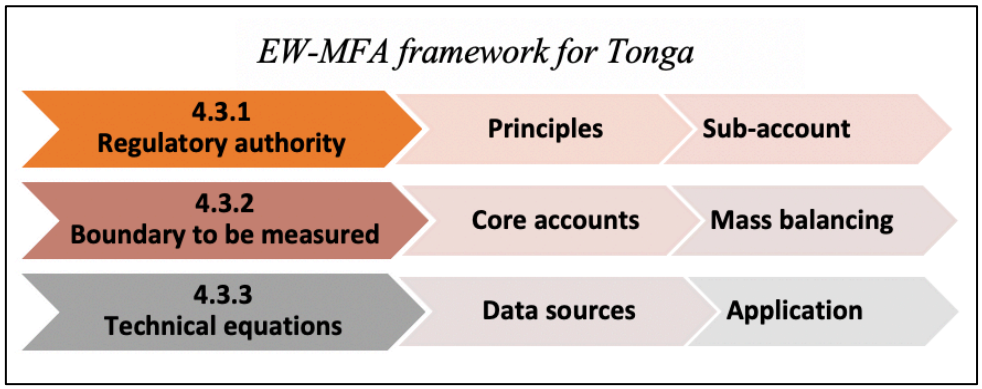
Introduction

The EW-MFA framework for Tonga is based on the model proposed by Mayer et al. (2019), as illustrated in *Figure 4.4* in the Annex[30]. This model, also adopted by Flanders (2021) for their 2018 EW-MFA, expanded earlier frameworks by incorporating ecological dimensions from the circularity butterfly (Ellen MacArthur Foundation, 2019), including biomass and fossil energy carriers. Previous EW-MFA approaches, such as those attributed to Ness and Xing (2017), focused primarily on metals and minerals. Wiedenhofer et al. (2019) advanced the model further by introducing the Dynamic Material Inputs, Stocks, and Outputs (MISO) framework to address challenges in managing Net Additions to Stock (NAS) and frequent data unavailability. These developments, both published in 2019, shaped the approach used in this study. The framework's adoption also considered SEEA principles (subsection 2.2.1). As a result, this study adheres to Mayer et al.'s comprehensive model, adapted in *Figure 4.4*.

[30] Subsequent mentions of the Annex in this chapter refer to the Annex appended to Chapter 4.

Figure 4.2 provides a visual synthesis of the method, presenting its technical elements in an accessible format. It guides the arrangement of the core components, showing how Regulatory Authority sets the foundational rules, System Boundaries define the scope of analysis, and Technical Equations derive actionable metrics for assessing resource use and sustainability. The complete technical details, data presentation, and computational processes, are provided in the Annex.

Figure 4.2. Proposed methodological EW-MFA framework for Tonga



Note: Methodology framework

4.3.1. Regulatory Authority

The EW-MFA is a module within Europe's Environmental Economic Accounting (EEA) framework, mandated by Regulation No. 691/2011 of the European Parliament and Council (EU Legislative Act, 2011). Although not yet obligatory for Pacific SIDS, the framework's alignment with five-yearly NDC reporting underscores its relevance to SD progress in the region.

Principles

EW-MFA is guided by three principles to ensure validity and robustness:

1. *Feasibility:* High-quality accounts must be compiled cost-efficiently.
2. *Non-perverse Indicators:* Capable of deriving directional indicators.
3. *Compatibility with SNA:* Boundaries must adhere to the SNA, as detailed in Section 2.3.

Sub-account

EW-MFA is established as a sub-account of the EEA-CF, providing a framework that directly supports the integration of environmental and economic accounting.

4.3.2. Boundaries to Be Measured

EW-MFA boundaries define the system's identity and the "points of measurement." According to SEEA-CF (2012), these boundaries represent the outer limits of the national economy and include: *Economic Territory* – Activities and transactions by resident producer and consumer units; *Exclusive Economic Zone (EEZ)* - Tonga's marine and atmospheric environments (see Annex).

Core Accounts

The EW-MFA consists of five core accounts that are essential for indicating socioeconomic metabolism:

i. *Domestic Extraction (DE):* Materials harvested or mined within Tonga.
ii. *Imports (IMP):* Materials entering Tonga's economy from other economies.
iii. *Exports (EXP):* Materials leaving Tonga's economy to other economies.
iv. *Net Additions to Stock (NAS):* Materials accumulated in infrastructure and products.

v. *Domestic Processed Outputs (DPO):* Waste and emissions leaving the economy.

Mass Balancing

Material Flow Analysis (MFA) adheres to the First Law of Thermodynamics, a conservation law stating, "Energy can neither be created nor destroyed in a system of constant mass, although it may be converted from one form to another" (Schmitz, 2016; Fischer-Kowalski et al. 2011). This principle yields the equation:

Input + Processed Materials = Output + Consumption + Accumulation

Where;

Input = all materials entering the system

Process Materials = materials processed within the system

Output – materials exiting the system

Consumption = represents the materials consumed or transformed within the system

Accumulation = the change in material stored within the system over a given period.

4.3.3. Technical Equations

Material flows are recorded in metric tons (Mt) and rounded to the nearest thousand to reflect Tonga's data volumes. Missing data were supplemented with reliable proxies based on Flanders (2021).

Table 4.1. Basic derived indicators for an EW-MFA

Derived indicator	**Code**	**Formula**
Domestic material consumption	DMC	DMC = DE + IMP – EXP
Direct material inputs	DMI	DMI = DE + IMP
Physical trade balance	PTB	PTB = IMP – EXP
Balancing Items (input - output)	BI	BI = Bi_in – Bi_out
Net additions to stock	NAS	NAS = DMC + Bi_in – Bi_out

Note: Adjusted from EU, 2018: Table 3, p. 27

Data Sources

Primary data were sourced from the UN Global Material Flows Database (GMFD, 2024), accompanied by a Technical Annex (CSIRO, 2024). These data were in turn cross-referenced with:

- Tonga Statistics Department (IMTS, 2022; National Accounts, 2021/22).
- Waste Management Audit (SPREP, 2023).

Tonga's DE figures were evaluated for consistency against regional data (Samoa and the Cook Islands) flagged in previous studies (Vea-Simpson, 2024) to address discrepancies.

Application

Tonga's 2022 material throughput, compiled in accordance with the EW-MFA framework, is detailed in the Annex and visualised as a Sankey diagram in the Findings section to illustrate material flows within the economy. This methodology provides a robust framework for quantifying Tonga's material flows, leveraging globally standardised principles to address critical environmental gaps in national economic accounting. While technical details are

inherently part of EW-MFA, they have been summarised here for accessibility, with further elaboration provided in the Annex. The outputs of this methodology offer actionable insights into Tonga's resource efficiency, trade dependencies, and sustainability planning.

4.4. Quality and limitations

The primary data source adheres to SEEA principles, emphasising (a) the feasibility of compiling accounts with sufficient quality in a cost-efficient manner and (b) the capability to derive non-perverse, directionally aggregated indicators. These principles guided the selection of source data.

To ensure data quality, several validation steps were undertaken. Data from the primary source, UN GMFD (2024), were cross-referenced with Tonga's International Merchandise Trade figures. Where gaps or inconsistencies arose, benchmarking against Cook Islands and Samoa was performed using findings from a previous study (Vea-Simpson, 2024, p. 147).

The zero-circularity rate was derived from the available 2022 material-flow data rather than assumed. Within the Eurostat (2018) and SEEA accounting framework, official national trade and accounts data were treated as higher-confidence direct evidence, while globally compiled material-flow data were used with greater caution where particular components warranted it, especially Domestic Extraction, for which the reported figure appeared excessive and could not be conclusively verified. National Accounts and SPREP waste data provided additional supporting evidence. Although local recycling activities are discussed elsewhere in the thesis, no domestic secondary-material flow was quantified in the available 2022 EW-MFA data. Recyclable material set aside for export was therefore treated as an output rather than domestic recirculation. The computed zero-circularity rate consequently reflects the available

quantitative evidence and the stated accounting treatment, subject to these source-specific limitations.

Despite these efforts, certain limitations remained unavoidable due to structural constraints. A key challenge in applying EW-MFA to Pacific SIDS lies in the comparatively underdeveloped nature of available data, which introduces inherent biases during decision-making. These limitations, detailed further in the Results section, emphasise the critical role of this study in highlighting the need for more robust data systems. While data constraints pose challenges, they underscore the importance of establishing baselines and advancing discussions on ST.

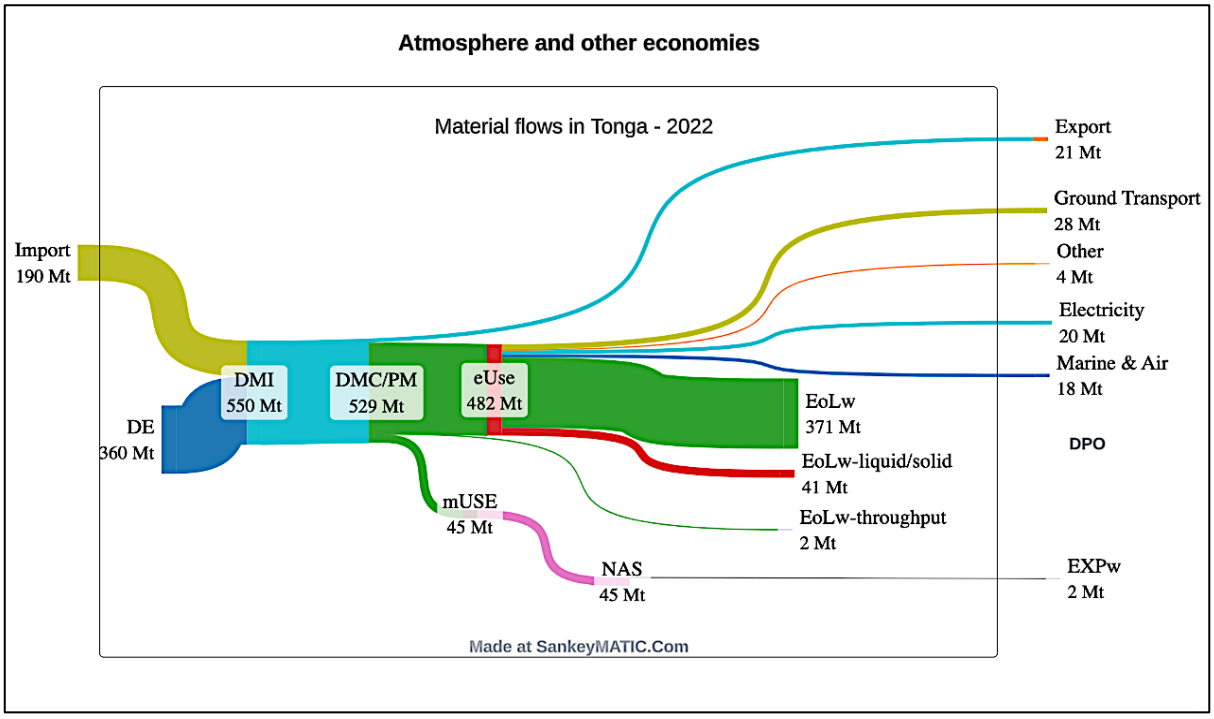
By carefully weighing SEEA principles and leveraging early-stage insights from EW-MFA framework evolution, the study offers a foundational contribution to sustainability research. Despite the outlined limitations, the rigorous application of SEEA principles and methodological triangulation ensured that the study findings remain robust and credible.

4.5. Results

The socioeconomic metabolism of Tonga in 2022 is marked by the flow of materials, energy, and waste, revealing the interconnected dynamics of resource use and environmental pressures. These are illustrated in the Sankey diagram (Figure 4.3). The analysis provides insight into the movement of physical resources through Tonga's economy, although the domestic extraction data warrants caution due to potential inaccuracies in the underlying source[31].

[31] https://www.resourcepanel.org/global-material-flows-database

Figure 4.3. Material Flows for Tonga in 2022



Legend

Boundary: *The inner triangle represents Tonga's socioeconomic boundary as measured in this study. The environment and other economies are positioned outside this boundary.*

Data: *The data are reported in thousands of metric tons (Mt).*

Core accounts: *Imports and Exports, Domestic Extraction (DE), Net Addition to Stock (NAS) and Domestic Processed Output (DPO).*

Other accounts: *Direct Material Inputs (DMI), Domestic Material Consumption (DMC), Processed Materials (PM), Energy Use (eUse), Material Use (mUse), End-of-Life Waste (EoLw), and Secondary Materials (SM). The results for Tonga indicate no* ***SM*** *since recyclable waste was exported. Consequently,* ***DMC*** *is treated as* ***PM*** *in this illustration, and no circular flows are present.*

Source. Author, created with SankeyMATIC

In total, 550,000 metric tons of direct material inputs (DMI) were processed within Tonga's economy in 2022. Of this, 360,000 metric tons (65%) were reported as domestically extracted (DE). However, this figure is subject to significant uncertainty, and readers are advised to interpret it cautiously. Efforts to validate these data were inconclusive, but they have been included here to provide a broader understanding of material flows. The remaining 190,000

metric tons (35%) of DMI were imported, reflecting Tonga's reliance on external sources to meet domestic needs.

The majority of DMI, amounting to 529,000 metric tons (96%), was allocated to domestic material consumption (DMC), while 21,000 metric tons (4%) were exported. Within the DMC, 482,000[32] metric tons (91% of DMC) were attributed to energy use (eUse), highlighting its significance in Tonga's resource metabolism. Of the eUse flow, 371,000 metric tons (77% of eUse) transitioned directly to end-of-life waste (EoLw), consistent with municipal waste audit findings indicating high levels of organic waste.

Fossil fuel-based materials, comprising approximately 70,000 metric tons (15% of eUse), were distributed across key sectors. Ground transportation accounted for approximately 28,000 metric tons (40%), followed by electricity generation at 20,000 metric tons (28%) and marine and air transportation at 18,000 metric tons (26%). The remaining approximately 4,000 metric tons (6%) were allocated to other uses. Liquid and solid waste amounting to approximately 41,000 metric tons (9% of eUse) remained in the economy as end-of-life waste.

Material use (mUse) accounted for approximately 45,000 metric tons (9% of DMC), comprising resources with a lifespan exceeding one year. Of this, approximately 43,000 metric tons (96% of mUse) were allocated to net additions to stock (NAS). The waste audit separately identified approximately 2,000 metric tons of metal waste set aside for export. As the source stock of this waste could not be identified, the Sankey diagram shows the export flow branching from NAS as a heuristic allocation, reflecting its closest association with durable material stock rather than a measured transfer from NAS. The material was already waste and earmarked for

[32] Small rounding discrepancies occurred during Sankey's mass balancing application.

export; it did not re-enter Tonga's productive system as secondary material and therefore does not affect the calculated zero-circularity rate.

Separately, single-use materials, classified under material throughput, totalled approximately 2,000 metric tons and were discarded after use. This figure highlights the prevalence of disposable products in Tonga's economy and the need for policy interventions to reduce waste and encourage resource recovery.

The study established a circularity rate of zero because no domestic secondary material (SM) was quantified as re-entering processed materials (PM) within the available 2022 material-flow data. This result underscores the absence of quantified closed-loop material cycles within Tonga's economy. Two key contributors to this outcome were identified. First, approximately 2,000 metric tons of recyclable waste were set aside for export and did not undergo domestic reprocessing. Second, the large amount of biomass EoLw, totalling 371,000 metric tons, remained largely unutilised, with minimal reuse through composting or other recycling processes. Together, these factors exemplify inefficiencies in Tonga's material management and reinforce the linear nature of its resource use.

The Sankey diagram vividly illustrates these material flows, emphasising the limited retention or reuse of resources within Tonga's economy. PM is calculated as the sum of DMC and SM. However, because no domestic secondary-material flow was quantified in the available 2022 data, SM is treated as zero and PM is therefore equivalent to DMC in this analysis.

Although this analysis provides a detailed overview of Tonga's material flows, the limitations of domestic extraction data introduce an element of uncertainty that must be acknowledged.

This issue will be revisited in the subsequent discussion to ensure that the findings are interpreted with due consideration of their potential inaccuracies.

4.6. Discussion

The findings of this study offer critical insights into Tonga's resource management systems, with broader implications for Pacific SIDS. The absence of closed-loop material cycles and a heavy reliance on imports underscore systemic inefficiencies. However, the analysis also highlights opportunities for targeted policy interventions and collaborative efforts to enhance Tonga's sustainability trajectory.

The dominance of energy use (eUse), which accounts for 91% of DMC, highlights the central role of energy flows in Tonga's material consumption. A substantial portion of this energy flow transitions directly to waste, aligning with broader trends in small island economies that lack advanced waste recovery systems (Dever and Every, 2002). At the same time, the reliance on imports for *35% of DMI* exposes vulnerabilities in Tonga's resource security, particularly in the context of global supply chain disruptions and rising energy costs.

The circularity rate of zero highlights the systemic challenges associated with material retention and reuse in Tonga. Two key contributors to this linear resource use are evident. First, approximately 2,000 metric tons of recyclable waste were set aside for export without domestic reprocessing, representing a missed opportunity for circular economy (CE) practices. Second, the substantial biomass EoLw, totalling 371,000 metric tons, remained largely unutilised, with minimal reuse through composting or other recycling processes. These findings demonstrate the limited domestic recovery captured in the available 2022 material-flow data and the opportunities for improving resource circularity.

The inclusion of Domestic Extraction (DE) data in the analysis warrants specific attention. The DE figure, sourced from the Global Material Flows Database (International Resource Panel, 2024), appeared excessive during initial reviews, and subsequent verification efforts were inconclusive. Despite these uncertainties, the figure was retained for the analysis to ensure completeness. However, its potential inaccuracy introduces an element of uncertainty that must be considered when interpreting the findings. While this limitation does not detract from the study's broader insights, it highlights the need for more robust and reliable data collection systems to enhance future material flow analyses in Tonga and similar contexts.

4.7. Conclusions

This study conducted the first Economy-Wide Material Flow Analysis (EW-MFA) for Tonga, a remote Pacific SIDS, for 2022. It quantified the volumes and dynamics of material flows, calculated the national circularity rate, and mapped Tonga's socioeconomic metabolism through Sankey visualisations to inform current and future policy directions.

The findings provide a foundational understanding of material flows within Tonga, revealing systemic inefficiencies in resource management. A circularity rate of zero reflects the absence of quantified closed-loop material cycles in the available 2022 data, while the dominance of energy flows transitioning directly to waste highlights critical inefficiencies in resource utilisation. Additionally, Tonga's reliance on imports for 35% of DMI exposes vulnerabilities in resource security, particularly amidst global energy price volatility and supply chain disruptions.

Despite these challenges, the study identifies substantial opportunities to enhance resource management and CE practices. The study's methodology, particularly the use of Sankey visualisations, equips policymakers and researchers with an innovative tool for mapping material flows and pinpointing inefficiencies. This approach provides a replicable framework for future studies and policy planning across Pacific SIDS, offering a pathway towards more sustainable and resilient resource management systems.

4.7.1. Policy Implications

The findings of this study offer actionable insights to support policy interventions aimed at fostering SD and improving resource management in Tonga and other Pacific SIDS.

Strengthening Data Collection Frameworks for EEA and EW-MFA

While efforts have been made to improve data-driven decision-making in Pacific SIDS, critical gaps remain in tracking material flows, resource efficiency, and circularity. Current data collection frameworks do not sufficiently capture the material flow insights needed for effective sustainability planning. Addressing these gaps requires aligning national data collection efforts with EW-MFA objectives and enhancing collaboration with SPREP and other regional organisations to ensure systematic data capture. Integrating this data into sustainability reports, economic policies, and climate strategies will improve its policy relevance.

Standardised data collection protocols should be adopted to enhance regional consistency and improve the accuracy of CE indicators. Additionally, investments in technical capacity-building and a strengthened regional monitoring system are essential to improve data reliability and enable informed policy decisions.

Support Sustainable Local Food Systems

A shift towards locally grown alternatives is essential to strengthen food security, reduce waste, and enhance economic and environmental resilience in Tonga. Policies should prioritise traditional agricultural systems that integrate small-scale livestock, such as pigs and chickens, which naturally consume food scraps and organic waste, reducing municipal waste. Remaining biomass should be reintegrated into the soil, closing nutrient loops and enhancing soil health. Ensuring these practices align with sustainable agriculture and cultural traditions will promote both environmental sustainability and economic self-sufficiency.

A key mechanism to achieve this transition is the establishment of a targeted farm development loan with favourable terms for smallholder farmers. This initiative should be complemented by a purpose-specific training programme that equips farmers with the necessary skills and knowledge to effectively implement sustainable agricultural practices.

To reinforce these efforts**,** a strategic campaign and promotional initiative should be introduced to re-engage communities with traditional agricultural practices. By highlighting the role of Indigenous agriculture in fulfilling cultural and material needs**,** this approach would redirect consumer preferences away from commercialised products that contribute to waste. Reaffirming the value of culturally sustainable consumption models, where traditional needs are met through locally sourced materials rather than imported disposable goods, not only preserves cultural identity but also actively reduces consumerism and minimises waste accumulation.

When combined, these strategies would establish a self-sustaining cycle of food security, environmental stewardship, and cultural preservation.

Incorporate Cultural Context in Policy Design

Beyond food security, policies should promote the revival of local production for essential non-food goods, such as medicinal plants, ceremonial decorations, and handcrafted valuables, reducing reliance on imports that contribute to waste. A dedicated training and support programme should equip artisans and producers with the skills to sustainably cultivate, process, and market these goods, ensuring their viability in modern economies while preserving traditional craftsmanship.

To strengthen adoption, public awareness initiatives should highlight the cultural and environmental benefits of locally sourced alternatives, reinforcing sustainable consumption behaviours that align with societal values. Embedding cultural sustainability principles into national policies will enhance community participation, promote resource efficiency, and support long-term resilience.

4.7.2. Adapt Policies to Address Long-Term Sustainability Goals

Ensuring long-term sustainability requires embedding CE principles into national education policies and governance frameworks. This transition depends on systemic education reforms that integrate resource efficiency, waste reduction, and sustainable consumption. Policies should mandate sustainability education within the next five years, equipping students and professionals with practical skills in circular strategies. Hands-on learning should emphasise traditional agricultural practices, material repurposing, and Indigenous ecological knowledge to align with cultural and environmental priorities.

Policymakers in Tonga and other Pacific SIDS can leverage these insights to address systemic inefficiencies and implement targeted strategies that drive sustainability, enhance resource efficiency, and strengthen economic resilience.

4.7.3. Opportunities for Future Studies

This study identifies priority directions for advancing socio-metabolism and related resource management in Tonga and other Pacific SIDS, with particular emphasis on improving material efficiency, strengthening local production to reduce import dependence, and fostering circular practices through cultural and behavioural change.

1. Expand comparative socio-metabolic profiles. Applying EW-MFA to other Pacific SIDS would enable cross-country comparisons, reveal shared and unique material-flow patterns, and identify critical data gaps.
2. Assess long-term impacts of local food systems. Longitudinal research should evaluate the public health, waste reduction, and food sovereignty outcomes of shifting from imported processed foods to locally grown alternatives.
3. Examine cultural and behavioural drivers. Understanding how cultural norms and consumer behaviour influence resource use can improve the design of interventions, particularly those promoting sustainable diets and traditional production methods.
4. Improve data quality and coverage. Addressing persistent data gaps in domestic extraction, capital stock, and construction and demolition waste would improve analytical accuracy and support stronger policy design.

By establishing the first EW-MFA baseline for Pacific SIDS, this study provides both a benchmark for Tonga's resource metabolism and a replicable framework for the region. It underscores the need to pair robust data with policy innovation, and regional collaboration to

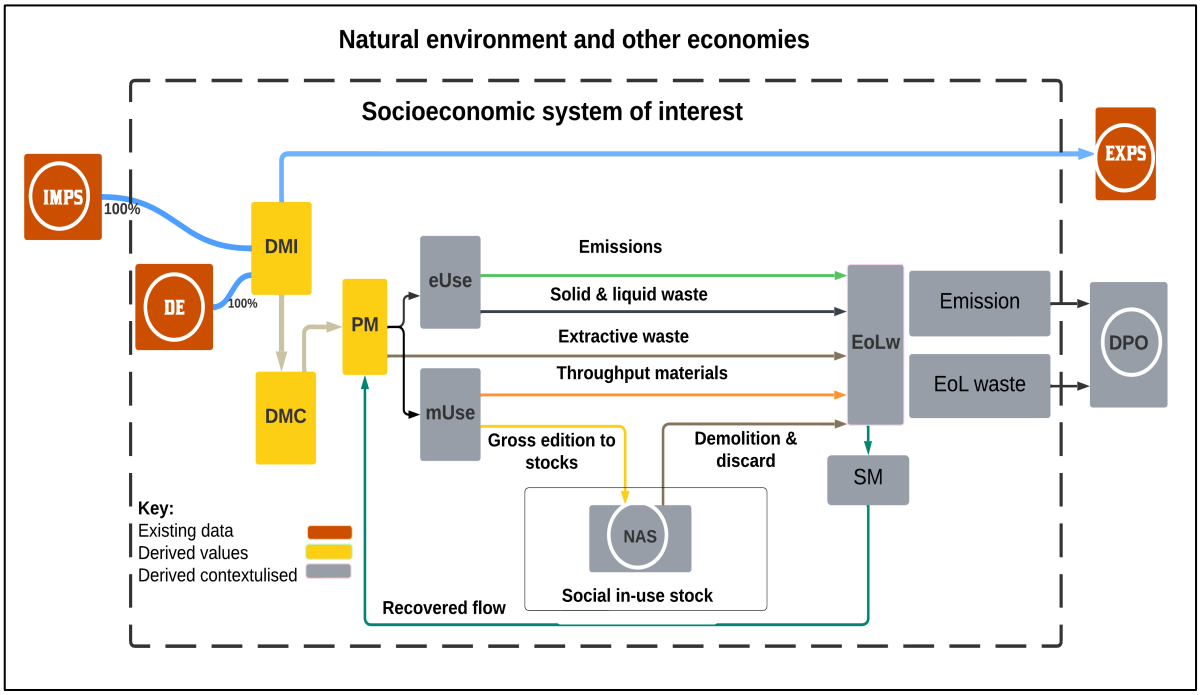
address systemic inefficiencies in resource management. As Tonga and its neighbours work toward circularity, these insights can guide more resilient, self-reliant, and SD pathways across the Pacific.

Annex for Chapter 4

Methods

An economy-wide material flow analysis of Tonga: Circularity and the Challenges of ST in Pacific SIDS

Figure 4.4. Economy-wide Material Flow Analytical framework for Tonga



Core accounts circled white: *Imports, Domestic Extraction (DE), Exports, Net Addition to Sock (NAS), Domestic Processed Output (DPO).*

Other accounts: *Domestic Material Consumption (DMC), Direct Material Imputs (DMI), Processed Materials (PM), energy Use (eUse), material Use (mUse), Secondary Materials (SM), End of Life waste (EoLw).*

Note. Adapted from Mayer et al., 2019

Principles

The SEEA framework establishes three principal conventions: (a) the feasibility of compiling accounts with sufficient quality in a cost-efficient manner; (b) the capability to derive non-perverse, directionally aggregated indicators; and (c) compatibility with the system boundaries of the SNA. The third convention supports the SNA and is integral to discussions of the ecosystem approach. However, the first two conventions can sometimes conflict with the SNA approach because of challenges related to data quality, exacerbated by reliance on coefficients to supplement missing data, which can significantly influence the quantitative outcomes of accounting. Moreover, classifying atmospheric CO_2 as a socioeconomic resource for consumption introduces substantial potential to distort these indicators (Fischer-Kowalski et al., 2011). Despite these challenges, the integration of economic and environmental information systems began in 1990 under the auspices of the European Statistical System (Eurostat, 2018) and has continued to evolve, culminating in the most recent EW-MFA Handbook (2018).

Several SEEA accounting requirements are omitted here because of the scope of this work, including Harvest & Scale, and supply and use tables (a parallel accounting transitional methodology)[33]. It is noteworthy that accounting for water and air, in general, is excluded from the EW-MFA because of their proportionally large results, which would render analytical utility impractical. The remaining essential principles are outlined below:

Sub-account of SEEA-CF

[33] Authors' interpretation

The EW-MFA operates as a sub-account within the System of Environmental Economic Accounting – Central Framework (SEEA-CF, 2012). The EW-MFA integrates economic and environmental data within a unified framework to assess the environment's contribution to the economy and the burden that the economy places on the environment. EW-MFA has not yet attained comprehensive technical support for accounting for the accumulation and discarding of NAS. Müller (2004) and Wiedenhofer et al. (2019) took steps in this direction, but the underdevelopment of NAS compounds and the uncertainty surrounding data requirements is a current obstacle. As a result, this study utilised a direct and simple approach to NAS (Table 2a). To re-emphasise, the EW-MFA is categorised as a physical flow account (EU, 2018), where materials are accounted for by mass. This indicates a shift from a purely economic focus to an environmental-economic paradigm.

Boundary to be measured

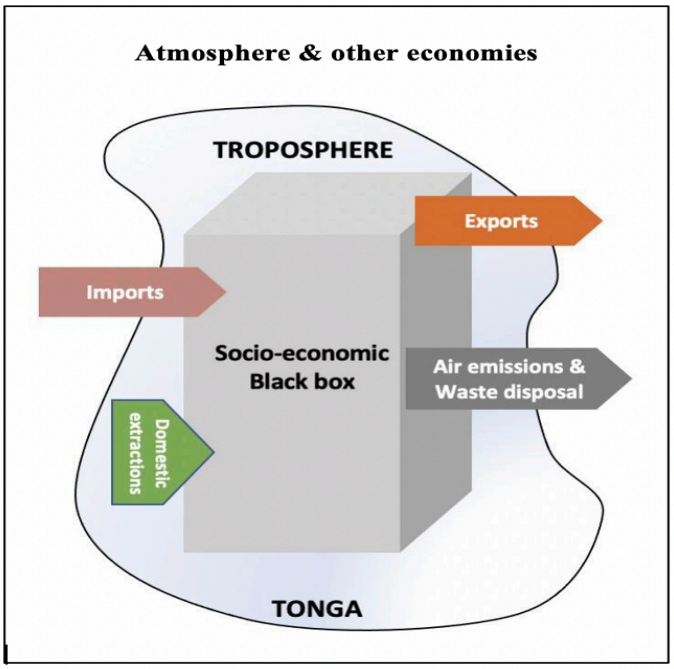
The boundary to be measured represents the outer boundary of the national economy, which is defined within the context of the national accounts as: "activities and transactions of producer and consumer units that are resident (i.e., have their centre of economic interest) on the economic territory of a country…" (European Commission, 2001, pp. 12 & 19).[34] In alignment with the SNA, the economy is delineated by the conventions of that system (Eurostat, 2017, p. 11).

Therefore, the boundary of interest for this study encompasses the national economy, natural environment, and the rest of the world economy. Figure 3 illustrates Tonga's EW-MFA boundary, marked by a dark line to include the exclusive economic zone (EEZ) from the Pacific

[34] Non-resident activities and transboundary flows of emission are not counted in the EW-MFA

Islands EEZ map.[35] The conceptual focus on EEZ highlights a unique aspect that sets SIDS apart from landlocked and continental nations. Additionally, this boundary extends beyond the ocean to include the corresponding troposphere, the lowest atmospheric layer by temperature classification (Hocking et al., 2016), which represents the entry point for emissions above Earth's surface. Outside the "crossing point" lies Tonga's external environment. The grey box symbolises the socioeconomic black box that the EW-MFA seeks to understand. Inputs to the socioeconomic black box (hereafter referred to as the economy) are derived from imports from other economies and domestic extracts from land and sea within the crossing point.

Figure 4.5. EW-MFA boundary for Tonga



Note. Authors' conceptualisation from the Eurostat Handbook

Core accounts

Centrality of the law of conservation mass

[35] Used with permission from NIWA, 19.06.2024: https://teara.govt.nz/en/map/6964/pacific-island-exclusive-economic-zones.

This approach not only provides a theoretical basis for the analysis but also facilitates the calculation of otherwise unavailable statistics. In addition, scientific studies have developed models to estimate the unreported data. These models have been extensively used in the MFA by Flanders (2021) and are similarly employed in this study.

Technical equation

Data sources

The absence of comprehensive data necessitated the use of modelling techniques, particularly those addressing the dynamic interactions between material flows and stocks. Deng et al. (2023) reviewed such approaches in a significant body of research. This discussion highlights the absence of complexities typical of industrial nations within Pacific SIDS data, that render certain modelling components redundant. This, in turn, presents opportunities to develop approaches uniquely tailored to the Pacific SIDS context. The fundamental premise of this EW-MFA is that material and energy consumption, emissions, waste, and circularity indicators are influenced by the size, wealth, and cultural drivers of the consumption patterns.

Application

Table 4.2. Tonga Material Throughput 2022 (Mt)

MF Code (EU, 2018)	***Physical Trade Balance***	***Domestic Extraction (DE)***	***Domestic Material Input (DMI)***	***Import (IMP)***	***Domestic Material Consumption (DMC)****	***Export (EXP)***
MF.1 Biomass.	19,226	359,557	387,872	28,314	378,783	9,088
Products from biomass.	33,575	0	33,654	33,654	33,575	78
MF.2 Metal ores.	4,095	0	4,121	4,121	4,095	25
Products from metals.	1,934	0	1,972	1,972	1,934	39
MF.3 Non-metallic minerals.	-585	0	10,884	10,884	-585**	11,469
Products from non-metallic minerals.	38,991	0	38,990	38,990	38,911	79
MF.4. Products from fossil fuels	70,345	0	70,360	70,360	70,345	15
MF.5 Other products.	1,567	0	1,655	1,655	1,567	89
MF.6 Waste for final treatment and disposal.	399	0	340	340	339	1
MF.7 Domestic processed output (DPO)	The outcomes for DPO will be calculated using the mass balance equation.					

*** DMC** for Tonga in 2022 is the same as process material (PM – Figure 4.3) which is the sum of DMC and secondary material (SM) given, recycling had occurred during the year. No recycling was recorded therefore DMC = PM

**The negative result for DMC MF.3 was the original figure recorded in the UN database. The study assumed this was a balancing necessity.

Table 4.3. Material flows derived from DMC

DMC **MF.2, MF.3** **MF.5**	**Energy use** **(eUse)**	**Material use (mUse)** **44,694****	**Material throughput** ***(End of life)*** ***1,567****†	**NAS**** **44,694**	**Export Waste** ***1,590****‡
		End of life Waste *(EoLw)*	Solid & liquid waste *(EoLw)*	Electricity	Ground transport
MF.1, MF.4	482,703	371,122	41,236‡‡	19,924	27,719
			Marine & air transportation	Others	
			18,224	4,478	
** Material use data MF.2, MF.3 & MF.5 are assumed to have more than year's useful life and all flow to NAS. The final result of NAS was calculated using mass balancing.					
*† Material use data MF.5 – Other products, 1,567 tons. represents materials used once and discarded					
*‡ Sourced from Tonga waste audit (2021/22). Used material set aside to be exported					
‡‡ Energy use data MF.1 & MF.4 assigned 10% to Solid & liquid waste upon averaging nutritional human					
Consumption to waste (AI generated). The balance of 371,122 flowed directly to End of Life waste.					

Note. Research data acquired from GMFD

Transition to Chapter 5

Chapter 4 directly addressed Objective 2 of this thesis, expanding on the groundwork established in Objective 1, which assessed the CE landscape across three Pacific SIDS. By applying the EW-MFA framework, Chapter 4 marked a significant methodological advancement, measuring for the first time the circularity rate within a Pacific SIDS. This novel application provided quantitative insights into production, consumption, and trade patterns, offering data-driven support for SD decision-making.

At this stage of the research, an emergent development led to a redirection in Chapter 5. Through community engagement and first-hand observation, the concept of social capital surfaced as an Indigenous enabler of sustainability, demonstrating strong alignment with the three pillars of SD identified in Chapter 3. This realisation prompted a deeper exploration of social capital from an Indigenous perspective, shifting the focus from material flows to the non-material foundations of resilience, wellbeing, and sustainability.

Chapter 5 therefore brings together two complementary components: a conceptual study originating from a conference paper, and an adapted version of the social capital paper developed subsequently. Together, these underscore the intrinsic value of social capital as an Indigenous resource, emphasising its foundation in human relationships, communal resilience, and cultural continuity. This perspective challenges conventional, material-centric interpretations of social capital, reframing it as a key driver of SD rooted in non-material values.

CHAPTER 5

Tongan Case Studies: Matryoshka Dolls of Social Wellness, and Social Capital

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Foreword

Ethics note. Case Study 1 is desk-based and uses policy documents and secondary data. Case Study 2 is included only in part: community permissions were obtained, but full Human Ethics Committee approval was not secured in time for the ethnographic data component. Accordingly, detailed ethnographic material requiring full Human Ethics Committee approval was excluded from the thesis. This limitation is discussed further in Section 7.5.3.

This chapter builds on the economy-wide material flow accounting (EW-MFA[36]) in Chapter 4 by examining the role of social capital in translating circular economy (CE) principles into practice in Tonga. While Chapter 4 quantified material flows and identified opportunities for greater resource efficiency, this chapter addresses the critical question of how such opportunities can be realised in ways that advance Sustainable Development Goals (SDGs) and nationally determined contributions (NDCs) while maintaining self-determination.

[36] EW-MFA is formally defined as Economy-Wide Material Flow *Accounting*, though it is also widely used as an *analytical* framework; in this thesis, both dimensions are implied.

Two interlinked case studies are presented. Case Study 1 examines social capital at the policy–system interface. Presented as an exploratory conceptual case, it employs the Matryoshka dolls metaphor to illustrate the nested relationship between SDG 3 (Good Health and Wellbeing), social capital, and socioeconomic metabolism.

Drawing on policy analysis and EW-MFA findings, it shows how integrating CE principles into health policy can reduce material waste, strengthen local resource use, and improve resilience to supply chain disruptions. Case Study 2 investigates the cultural foundations of social capital through the Tongan concept of *koloa* ("treasure" or "endowments"), positioned as the "ontological black box" of relational wealth. Using an ethnographic approach and three community-based projects at micro, meso, and macro scales, it demonstrates how values such as respect (*faka'apa'apa*), relational maintenance (*tauhi vā*), humility (*loto tō*), and selfless commitment (*mamahi'i me'a*) are mobilised to achieve collective goals.

Together, these case studies connect policy-level CE frameworks to the lived cultural realities that determine their success. The findings show that in Pacific small island developing states (SIDS), achieving CE-aligned SDG and NDC targets requires not only technical interventions to improve resource efficiency, but also culturally grounded strategies that strengthen self-determination and activate the social capital embedded in local communities.

This research contributes to the overarching thesis by recognising social capital as a key enabler of Indigenous resilience, particularly in navigating pathways toward sustainable development. This insight was sharpened through the researcher's direct community engagement, notably through collaboration with the leadership of the Tongan Nurses Association. Their governance and public engagement strategies highlight how social networks, trust, and reciprocity function

as critical assets in the sustainability discourse. This chapter builds on that perspective by examining the interplay between social capital, SDG 3, and Tonga's socioeconomic metabolism.

5.1. Case study 1: Harmonious Layers of Social Wellness: Unravelling the Russian Doll of Socioeconomic Metabolism, Social Capital & Social Wellbeing.

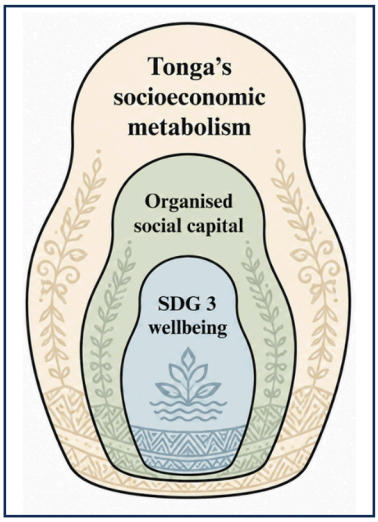
Abstract

The nested relationships symbolised by the Russian dolls metaphor offer a valuable framework for harmonising interconnections between socioeconomic metabolism, social capital, and social wellbeing, particularly in the context of SDG 3, ensuring good health and wellbeing for all. This study applies the metaphor to Tonga, exploring how these dimensions shape sustainable development pathways.

The outermost "doll" represents socioeconomic metabolism, derived from EW-MFA, which quantifies production, consumption, and resource flows. The middle layer encapsulates social capital, the networks, relationships, trust, and reciprocity that facilitate collaboration and economic productivity. The innermost doll represents individual wellbeing, particularly SDG 3.4 (reducing premature mortality) and SDG 3.5 (preventing and treating substance abuse). Figure 5.1 depicts this relationship.

This case study draws on policy analysis and EW-MFA findings, focusing on the Ministry of Health's plans as aligned to the national SDG framework and interpreted in relation to Stiglitz's framing of social capital from the World Bank's pre-millennium discussions. This approach demonstrates how the three layers function harmoniously but also reveals tensions in Tonga's current development trajectory. While focused on SDG 3, the framework is applicable to other SDGs.

Figure 5.1. Matryoshka Dolls



Vea-Simpson conceptualisation

Summary – in Tongan

A summary of the paper was given in Tongan to the predominantly Tongan audience at the International Tongan Nurses' Conference.

'Oku ou kole ke u hūfanga he tala-fakatapu kakato kuo aofaki he konifelenisí ni.

Faka'apa'apa ki he ngaahi tu'unga kotoa 'oku fa'a fakatapua, Tala, ngata 'iate au, 'o fai ki tu'a mama'o, tuku mu'a ke u ngāue'aki ha ngaahi lea mahino, ka e hoko atu e fatongia leá ni.

Ko hono fakamā'opo'opo faka-Tongā eni – ka e toki hoko atu e fakahoha'á, fakapālangi.

Figure 5.2. International Tongan Nurses Association Conference, 2023



Source: Vea-Simpson

Ko e 'ulu'i kaveingā – ko e Napangapangamālie 'a e ngaahi fungavaka 'o e mo'ui lelei 'a e sōsaietī: 'I hono tatala 'a e Tamapua Lūsia 'oku ne fālute 'a e 'elemeniti ko e sino 'o e fonuá, mafai ngāue fakataha 'o e kakaí, pea mo e mo'ui lelei 'a e kakaí, 'oku 'i he Palani Fakalakalaka Tu'uloa Fika 3.

Ko e taumu'a ia 'o e fakatotolō – ke folahi atu 'a e fekau'aki 'a e ngaahi me'a ko ení 'e 3. 1. Ko e ngāue 'a e Potungāue Mo'uí ki he mo'ui lelei 'a e kakai 'o e fonuá, 2. Ke fakatokanga'i 'a e mahu'inga 'o e mafai fakakulupu he sōsaietí ke ne tokonia 'a e ngāue fakapotungāué, pea ko e 3. Ke tokamālie 'a e 'ātakai 'o e fonuá pē ko hono ecosystem. He ko e tokamālie 'a e ecosystem te ne fakatōli'a mai 'a e feima'u fakaesino 'a e kakai 'o e fonuá pea ma'ama'a ange 'a e ngāue ki he mo'ui lelei 'a e kakaí, fakafo'ituitui. 'Oku ou ngāue'aki 'a e tamapua Lūsia. Ko e 'ū tamapua lahi - 'e hao 'i loto he tamapua pē 'e taha. Ko e fakataipe 'a e nofo mo e fengāue'aki lelei 'a e ngaahi kaveinga mahu'inga kotoa ko ení 'e tolu.

I extend my sincere appreciation to the organisers of the 6th International Tongan Nurses' Association Conference for providing me with the opportunity to present my research in alignment with the conference theme.

I also wish to acknowledge the invaluable guidance of my supervisory panel chair, Professor Matthew Roskruge, Associate Dean, Māori, at Massey University, and the co-supervisor, Dr. 'Apisalome Movono, from the advisory panel of the Council of Chiefs in Fiji. Their support and mentorship have been instrumental in shaping the direction of this research.

5.2. Context and Framing

The theme of the 6th International Tongan Nurses' conference, '*Napangapangamālie*: *Working in Harmony'*, provided an ideal platform to share this work. The research takes a systems perspective, asking:

- How do resource flows, social capital, and wellbeing interconnect?
- How can these be better integrated into Sustainable Development Goal (SDG) 3 strategies?

The Russian doll metaphor (Matryoshka) serves as a visual and conceptual device:

- Innermost doll – Social wellbeing (individual and community health outcomes)
- Middle doll – Social capital (networks, institutions, norms)
- Outermost doll – Socioeconomic metabolism (material and resource flows)

Integrating these layers provides a coherent framework, offering greater clarity and direction for advancing SDG 3 objectives. The next section outlines how this framing is applied in Case Study 1 to analyse the policy–system interface.

5.3. Method

Case Study 1 examines social capital at the policy–system interface, grounded in desk-based analysis of policy documents and secondary government data. It employs the Matryoshka (Russian nesting dolls) metaphor as an analytical heuristic to illustrate the nested interconnections between socioeconomic metabolism, social capital, and social wellbeing. The metaphor has been widely used across disciplines to depict systems within systems, for example, in ecological psychology, where Bronfenbrenner's (1979) ecological model has often been described as Russian dolls; in layered models of empathy (de Waal, 2008); in cultural analysis of science and society (Etkind, 1998); and in studies of nested meaning-making in global change (Hochachka, 2019).

Adapted here, the metaphor emphasises how health and social capital are not simply influenced by socioeconomic metabolism but are inherent parts of it: social wellbeing is sustained within, and enabled by, social capital, while both constitute the living mechanisms of socioeconomic metabolism itself. For example, health outcomes are directly linked to metabolic processes such as food and energy use, while social capital represents the human networks and relationships that mobilise and sustain these processes. This framing aligns with the conference theme of "working in harmony" and provides a structured way to visualise how health outcomes (SDG 3) are inseparable from the broader social and metabolic systems in which they are embedded. Positioned at the policy–system interface, this case study bridges the material analysis of Chapter 4 with the cultural analysis developed in Case Study 2.

5.4. Literature

The case study draws on three interconnected bodies of literature to frame the analysis of how CE principles can be integrated into Tonga's health sector. Industrial ecology provides the conceptual and analytical foundation, linking material flows to socioeconomic systems. Social capital offers a lens to understand the relational networks, trust, and collective action that enable policy adoption and implementation. SDG 3 situates these concepts within the global-to-local policy architecture, highlighting how international commitments shape national health strategies. Together, these literatures establish a systems perspective for examining the policy-system interface in a Pacific SIDS context.

5.4.1. Industrial ecology

Ayres (1997) identified industrial metabolism as a concept rooted in industrial ecology. The former represents the mechanistic process of material and energy transformation, and the latter framing these processes within the dynamics of natural ecosystems. In this view, human production and consumption systems should operate analogously to biological and ecological systems, where waste for one process becomes a resource for another. This principle underpins the CE's emphasis on closed-loop flows. Essentially, waste from one part of the ecosystem should serve as a nourishment for the other. Figure 5.3 illustrates an industrial park which conceptually represents the principle of industrial ecology.

Figure 5.3. Impression of an industrial park



Source: AI generated

Building on this foundation, Pauliuk and Hertwich (2015) note that EW-MFA emerged from industrial ecology as a tool to quantify the socioeconomic metabolism, the flows of materials through an economy. Haberl et al. (2016) trace the origins of this concept to social ecology, linking material flows to social organisation and environment impact. At a global scale, the industrial ecology research community, in collaboration with the United Nations Environment Programme, has developed a 40-year dataset on material extraction and trade, providing a critical benchmark for analysing long-term trends (Schandl et al, 2015).

This lineage situates EW-MFA as both a methodological and conceptual bridge between ecological principles and policy-relevant indicators. In the context of Tonga, it offers a way to connect CE strategies in the health sector to broader sustainability objectives, aligning with the global framework initiated by the Brundtland Report (1987) and embedded within the SDGs.

5.4.2. Social capital

Social capital refers to the resources embedded in social networks such as trust, reciprocity, and norms that enable individuals and groups to act collectively and more effectively (Coleman, 1988; Roskruge et al., 2013). Development literature has long recognised its significance for enabling cooperation, facilitating information exchange, and sustaining collective action. A seminal compendium following the World Bank's 1999 workshop on social capital (Dasgupta & Serageldin, 1999). Brought together diverse perspectives, reinforcing the concept's relevance for development policy. Among these contributions, Stiglitz argued that building social capital could be most effectively supported through state-based mechanisms, complementing rather than replacing cultural and community structures.

In Tonga, this interplay between cultural and institutional forms of social capital is evident in organisations such as the Tongan Health Promotion Foundation, established under the Health Promotion Foundation Act 2007. This represents a shift from solely relying on traditional community networks to incorporating formal bureaucratic structures to address public health challenges.

Historically, as Chhibber (1999) observes, the mid-20th century surge in development, particularly following World War II, highlighted that national differences in economic performance were shaped not only by physical resources but also by intangible assets such as knowledge, technology, and human capital. As formal institutions, expanded, the synergistic qualities of social groupings gained recognition as a distinct form of capital, integrating social and economic perspectives in development discourse.

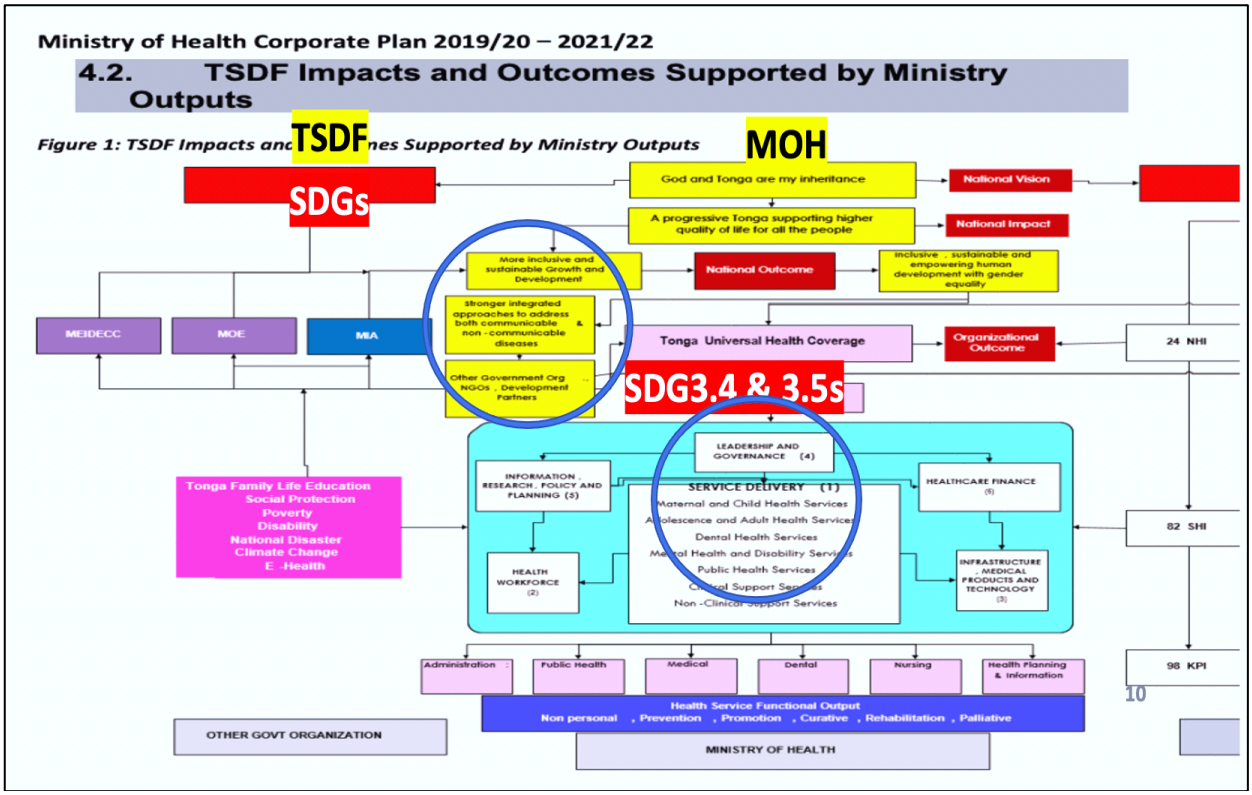
For Tonga, where strong kinship ties, church affiliations, and village-based networks remain central to social organisation, social capital is both a cultural inheritance and a strategic asset. It shapes the ability of communities and institutions to implement CE initiatives, particularly those requiring behavioural change, collective resource management, and resilience to external shocks.

5.4.3. SDG 3

SDG 3, Good Health and Wellbeing, provides an international framework for improving health outcomes while supporting broader social, economic, and environmental sustainability. Two targets are of particular relevance to this case study: SDG 3.4, which aims to reduce premature mortality from non-communicable diseases through preventions, treatment, and health promotion; and SDG 3.5, which seeks to strengthen the prevention and treatment of substance abuse. These targets are embedded within the 17 SDGs adopted in 2015 as part of the global commitment to the Paris Agreement, with signatory states required to report progress through national strategies and ministerial action plans.

In Tonga, these targets are integrated into the *Tonga Strategic Development Framework* (TSDF) and operationalised through the Ministry of Health's corporate plans. For example, the Ministry of Health's 2019/20-2021/22 (Government of Tonga MoH, 2019) plan explicitly links SDG 3.4 to its strategic objectives, aligning national health priorities with the global commitments (Figure 5.4). This alignment not only frames the country's health sector goals but also shapes the responsibilities and resourcing of health professionals, including nurses, in delivering prevention-oriented, community-based health interventions.

Figure 5.4. Tongan Government SD Framework feeding into the MoH Corporate Plan



Source: Author's adaptation of official public information as noted in the text

From a systems perspective, SDG 3 provides an essential bridge between *industrial ecology* (as a means to improve efficiency and reduce health-related resource burdens) and *social capital* (as a means to mobilise communities and sustain behavioural change). In a Pacific SIDS context, where health systems face resource constraints and high exposure to external shocks, integrating CE principles into SDG3-related policy offers the dual benefits of improving health outcomes and reducing dependency on imported medical and food resources.

In sum, these three literatures provide complementary perspectives on how the industrial ecology framework, the concept of social capital, and the global policy architecture of SDG 3 offer a systems-level lens for embedding CE principles into Tonga's health strategies. This conceptual foundation frames the case study analysis that follows.

5.5. Nesting dolls

To frame the interconnections between health, social structures, and material flows, this case study employs the Russian nesting dolls metaphor as its analytical framework. Each "doll" represents a distinct but interrelated layer of the system: the innermost concerns specific health goals (SDG 3.4 and SDG 3.5), the middle embodies the enabling role of social capital, and the outermost reflects the wider socioeconomic metabolism. Moving from the smallest to the largest layer illustrates how targeted health interventions are embedded within broader social networks and, ultimately, within the metabolic systems that sustain or constrain them.

5.5.1. Innermost doll – social wellbeing

The innermost layer of the nesting doll represents the most immediate and tangible goal of improving population health and wellbeing. Within the SDG framework, SDG 3.4 commits to reducing premature mortality from non-communicable diseases (NCDs) by one-third by 2030, pursued through prevention, treatment, and the promotion of mental health and wellbeing. Complementing this, SDG 3.5 seeks to strengthen both the prevention and treatment of substance abuse, targeting harms linked to alcohol and drug misuse. Together, these targets aim to cultivate healthier communities and reduce the burden of preventable disease.

Tonga has responded proactively to these global mandates through targeted national strategies. Between 2015 and 2020, and in alignment with the Ministry of Health's strategic vision, Fakakovikaetau et al. (2015) produced an evidence-based epidemiological report that articulated an urgent health challenge for the nation. Guided by the principle *"Preserving together through crisis to a healthier Tonga,"* the report outlined four primary objectives, each designed to advance the Ministry of Health's five-year Strategic Plan.

Central to these objectives was tackling obesity and promoting healthier lifestyles. To reinforce its recommendations, the team drew on the WHO's *Global Strategy on Diet, Physical Activity and Health* (2004), which identifies ten policy areas influencing food procurement, accessibility, education, and personal choice. Together, these domains are critical to achieving both "household food security" and nutrition security.

Implementing these interventions, particularly those in the fourth goal, required strong measures. The WHO emphasised mass media campaigns as a "best buy" for advancing population health objectives. Such campaigns deliver *"consistent, precise, straightforward, and unequivocal messages"* across multiple platforms, tailored to local customs, age group, and gender dynamics. These targeted health strategies cannot succeed in isolation; they rely on the enabling relationships, institutions, and trust networks of the next layer — social capital.

Figure 5.5. Inner layer



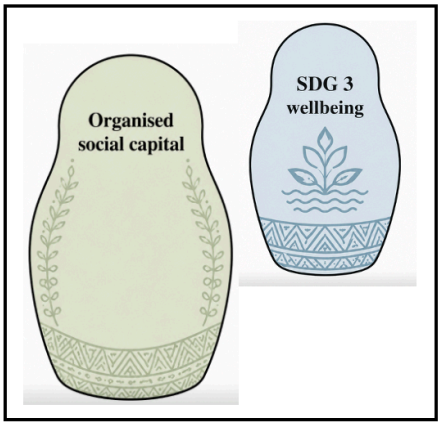
Vea-Simpson's construct

5.5.2. Middle doll – social capital

The next layer of the nesting doll represents social capital, the networks, relationships, and norms that enable collective action. Within the Tonga National Strategy for the Prevention of

NCD 2021-2025 (p. 13), the ministry of Health frames its approach as a systems-based approach.

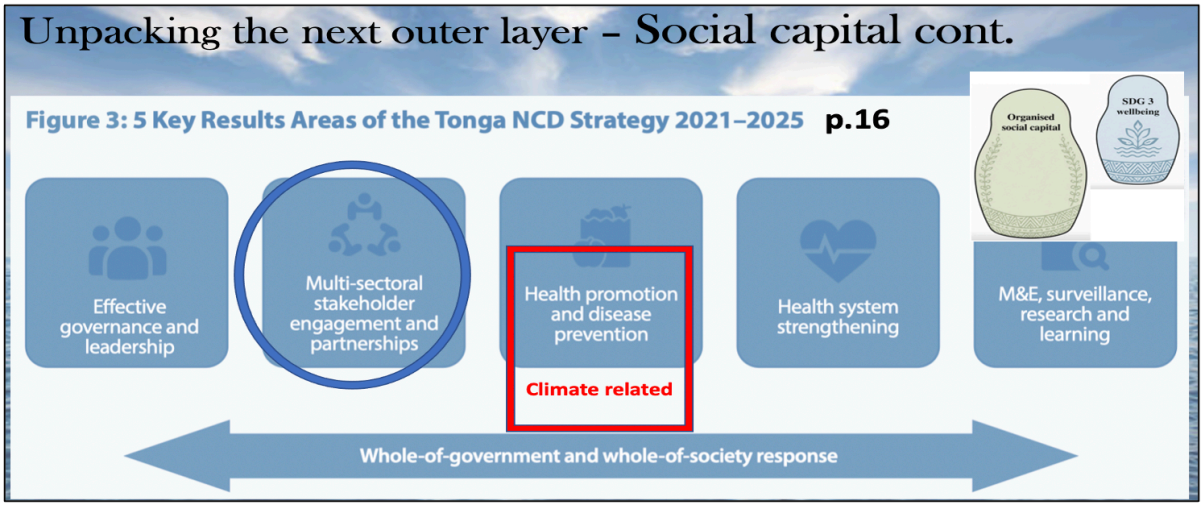
Figure 5.6. Middle layer



Vea-Simpson's construct

The preceding *Tonga National Strategy for NCD Prevention 2012-2025* (Figure 5.4) identifies Key Result Areas that place strong emphasis on multi-sectoral stakeholder engagement and partnership (Figure 5.7).

Figure 5.7. Tonga MoH multi-sectoral stakeholder engagement framework

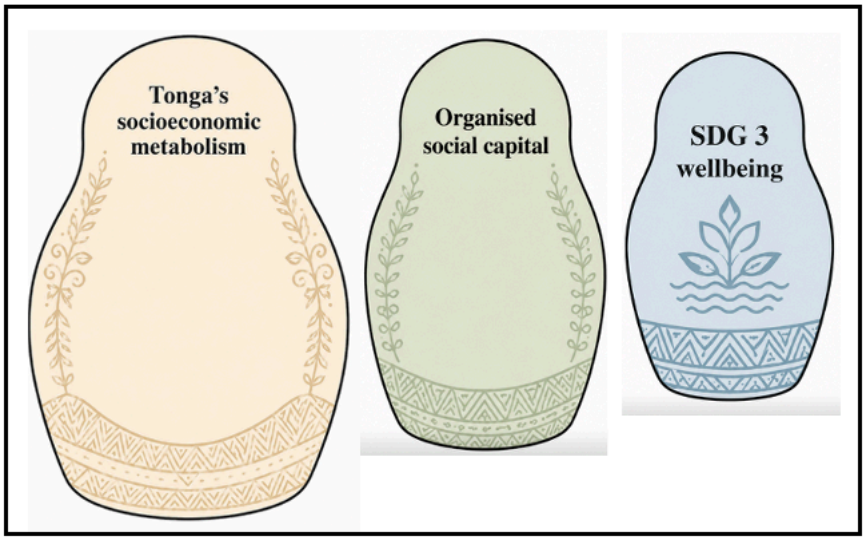


Source: Official Public information noted in the text

This approach is visible in the composition of the National NCD Committee, which includes two members from the Tonga Health Promotion Foundation – a state-based social capital organisation identified in the literature review. Three additional members represent the wider public, drawn from commerce and business, civil society and the national forum of church leaders. The remaining five members are drawn from various government ministries. Consistent with Stiglitz's typology, this structure reflects a stronger emphasis on *bureaucratic* rather than culturally based forms of social capital.

Following WHO guidance, the Ministry of Health's objectives stress the importance of broad public buy-in. This includes deliberate engagement with community and public initiated groups, recognising that social capital is a critical enabler for achieving public health and wellbeing goals. In the context of the nesting doll analogy, this larger layer connects the individual and community health goals at the core to the broader material and systemic flows in the outermost layer, socioeconomic metabolism, explored in the next section.

Figure 5.8. Outer layer



Vea-Simpson construct

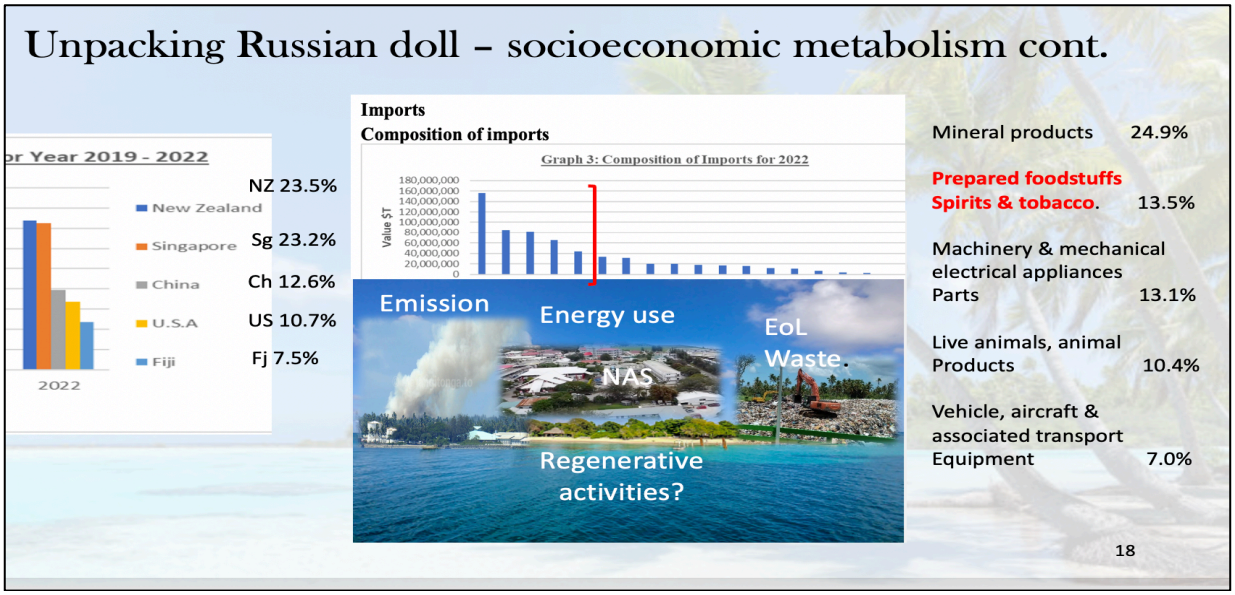
5.5.3. Outermost doll – socioeconomic metabolism

The outermost layer of the nesting doll metaphor represents socioeconomic metabolism. Imagine a nation functioning like a living body: just as the body consumes food for immediate energy and growth, nations draw in resources to sustain and advance their development. Likewise, as bodies produce waste that re-enters ecological cycles, nations generate waste and often damaging externalities.

Analysing a nation's socioeconomic metabolism through EW-MFA offers valuable insights into the effectiveness of sustainable development (SD) initiatives, particularly in relation to SDG 3. EW-MFA records the inputs of a national economy (imports and resource extraction), the outputs (emissions, end-of-life waste), and the additions to physical stock (NAS), along with regenerative or recycling activities. Reported annually, this accounting provides a profile of how materials flow through and are transformed by the economy.

Tonga's 2022 International Merchandise Trade Account shows that 69% of total imports fall into five categories. Prepared foodstuffs, beverages, spirits, and tobacco form the second-largest group, accounting for 13.5% of total imports. Notably, these items have a direct bearing on SDG 3.4 and SDG 3.5. Figure 5.9 reconstructs this data from publicly available sources. As noted in the literature review, material flow accounting has now been standardised internationally, enabling consistent comparison across nations.

Figure 5.9. Socioeconomic metabolistic & human health related items



Source: Author's construct form Tonga's Trade Account 2022 (Public Information)

In 2014, Giljum et al. analysed 29 years of global material use (1980–2009). Their findings showed that Oceania had taken few measures to limit resource extraction or improve sustainability. Although the global average was somewhat better, it remained insufficient. Nearly a decade later, with only seven years remaining until the 2030 SDG deadline, the most significant intervening disruption has been the Covid-19 pandemic. Giljum et al.'s conclusions are echoed in the Circularity Gap Report 2023, which shows global material extraction accelerating and the circularity gap widening from 90.9% in 2018 to 92.8% in 2023, a concerning trajectory.

Within this context, Tonga is preparing to construct a $45 million international wharf, an investment aimed at strengthening economic development and enhancing resilience to climate-related disasters. Yet such projects also highlight an enduring tension: while they address immediate development and resilience needs, they reflect a growth-oriented trajectory that disregards the circular economy objective of material decoupling. This example illustrates the

dynamic interplay between material flows, health, and infrastructure, and provides a fitting bridge to the discussion and conclusions that follow.

5.6. Discussion: Linking the dolls

Viewed through the interpretative lens of the Russian doll metaphor, the interdependence of the three concepts becomes clear. SDG3.4 and 3.5 sit at the innermost layer, reliant on a strong social capital to translate health goals into sustained community action. This need is reflected in the Ministry of Health's strategies for health promotion and prevention (p.16), reinforced by governance arrangements that embed social capital and endorse a systems-based approach. These, in turn, connect to the outer layer of socioeconomic metabolism, particularly when considering the structural drivers of NCDs such as lifestyle, globalisation, and climate change.

Two philosophical incongruities emerge from the study:

a) Despite explicit acknowledgement of both health and environmental crisis, a "business as usual" trajectory persists. High levels of imports, particularly prepared foods, tobacco, and other harmful products, drain national finances and foreshadow additional public health costs, yet major investment priorities still include infrastructure such as the $54 million upgrade to the international wharf. This approach appears misaligned with the broader goal of meeting the global 1.5^0 C climate target for 2030.

b) A deeper concern arises from the foundations of social capital itself. In Tonga, religious faith is a central source of identity and collective strength, reflected in the representation of church leaders within the National NCD Committee. Faith mobilises communities and sustains trust much like the lifeblood of the nation's body. Yet here a tension emerges: while faith traditions celebrate the abundance and resilience of land and sea — as

expressed in Methodist Hymn 659 v. 4, this worldview can sit uneasily alongside the scientific consensus on environmental vulnerability and human-induced climate change. This dissonance underscores the challenge of aligning cultural values with global sustainability frameworks.

Together, these tensions raise a critical question: can Tonga achieve its climate and health objectives within the framework of its existing values and development path, or will it need to reconcile these competing trajectories to meet its SDG commitments? The risk is that continual emphasis on imported growth models blinds policy to the very resources already sustaining the nation, producing metabolic outcomes that undermine both health and resilience. As Moulton observed over a century ago, Tonga was endowed with prolific resources — coconuts, yams, bananas, kumala (sweet potato), fish - which met the needs of its people, who were content without the corroding demands of the "more civilised world" (Moulton, 1914, p. 42). In this light, the hymn celebrating the land and sea's abundance speaks not of denial but of recognition: that Tonga's wellbeing depends on turning back to these foundations. Indigenous worldviews thus offer not conflict, but a pathway to achieve the SDGs, provided communities are empowered to advance them on their own cultural and ecological terms.

5.7. Case study 1 Conclusion

This case study shows that achieving Tonga's SDG 3.4 and SDG 3.5 targets is not only a matter of public health policy, but also a systems challenge that spans social structures and material flows. The inner layer of the "nesting dolls" analogy highlights health objectives framed within international commitments, the middle layer demonstrates that their realisation depends on the depth and configuration of social capital, and the outer layer situates these efforts within the

nation's broader socioeconomic metabolism, a metabolism shaped by high dependency on imported goods, with adverse health and environmental impacts.

Together, these layers reveal both opportunities and tensions for advancing a CE in Tonga's health sector. Social capital offers a mechanism for mobilising communities and building legitimacy for circular strategies, but it is also embedded in institutional and cultural contexts that can either accelerate or resist change. At the same time, Tonga's dependency profile constrains the scope of circularity, reinforcing vulnerabilities that threaten both health and self-determination. Unless these constraints are addressed in an integrated way, efforts to meet SDG health targets risk being undermined by the very factors they seek to reform.

Case Study 2 draws on the researcher's direct involvement in three major community projects, offering a unique opportunity to extract knowledge from lived experience. Through this lens, it develops theoretical perspectives on how different forms of social capital can support or hinder the embedding of CE principles in Pacific SIDS. By situating community practice alongside broader sustainability frameworks, it highlights the potential of Indigenous social capital as both a resource for resilience and a pathway for sustainable transition.

5a.1. Case study 2: Social Capital

Abstract

This case study examines the Tongan concept of *koloa* (treasure, endowment) as a culturally grounded framework for revealing deeper, often overlooked dimensions of social capital. In Tongan traditions, *koloa* extends beyond material wealth to include emotional support, purpose, skills, and knowledge, offering a holistic and relational understanding of value.

Drawing on ethnographic insights from community projects at the micro, meso, and macro levels, the study positions *koloa* as both a dynamic expression of social capital and an ontological lens for understanding its cultural foundations within Indigenous knowledge systems.

By situating *koloa* within contemporary sustainability discourse, the case study bridges individual, relational, and systemic dimensions of social capital. It highlights *koloa's* role in fostering community resilience and its potential to inform culturally attuned SD strategies. The analysis concludes by suggesting directions for future quantitative research to test *koloa's* applicability and explore its transformative potential across diverse cultural contexts.

5a.2. Cultural and Theoretical Foundations of *Koloa*

This case study examines the cultural foundations of social capital in Tonga through the lens of *koloa*, a Tongan concept of wealth that encompasses both material and intangible dimensions, including emotional support, purpose, skills, and knowledge. Rooted in communal relationships and cultural traditions, *koloa* offers a relational and holistic view of value, expanding social capital beyond quantifiable assets to include the cultural scaffolding that sustains them.

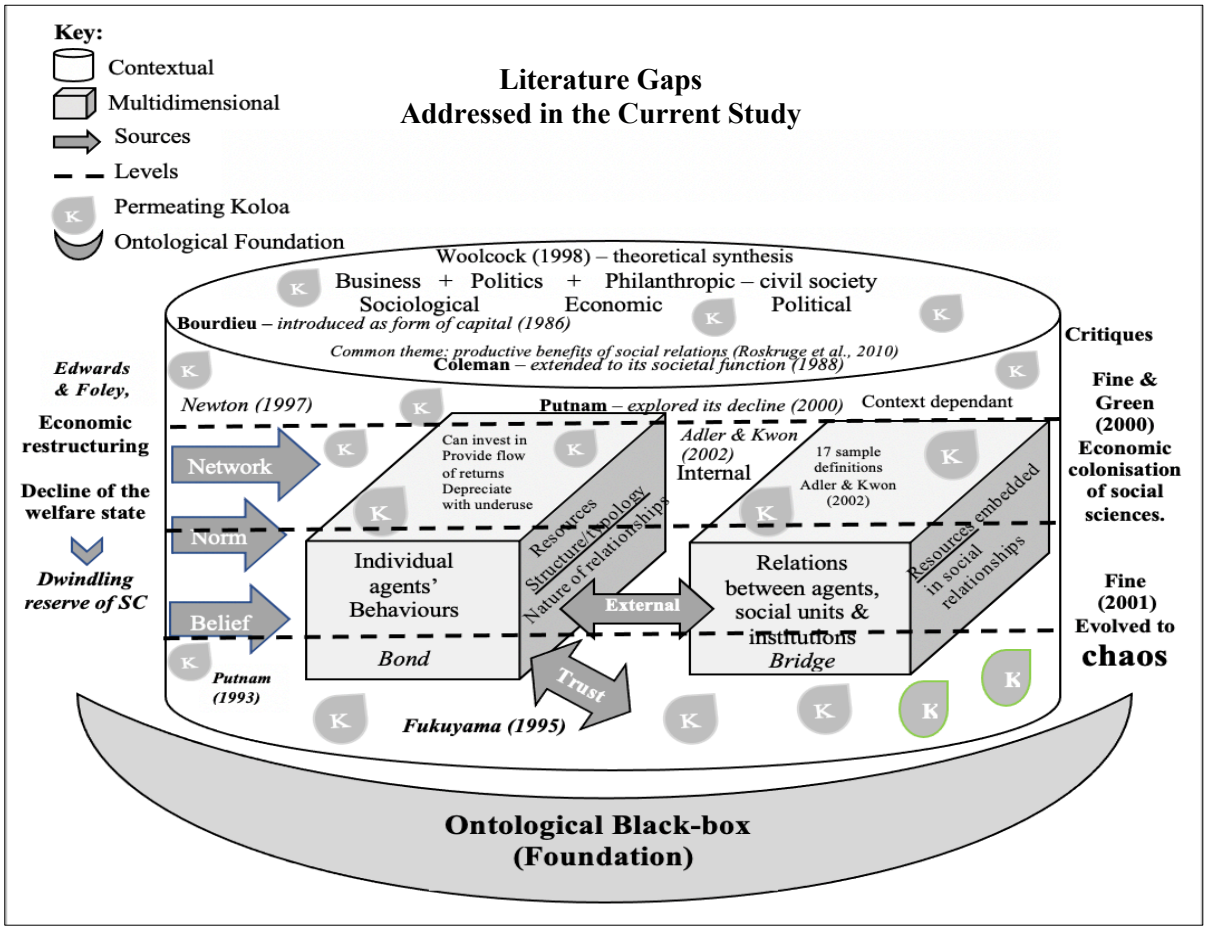
Social capital scholarship has typically advanced through studies of its sources, levels, contexts, and dimensions. Yet these approaches often privilege measurable outcomes and universalise theoretical models. *Koloa*, by contrast, embeds these elements within a culturally grounded ontology, offering a lens that foregrounds cultural specificity and relational value.

Koloa thus provides a unifying frame that bridges individual relations, collective obligations, and systemic values, offering an interpretive foundation for understanding social capital in Tongan society.

5a.2.1. Existing Approaches to Social Capital

The literature on social capital spans diverse theoretical approaches, examining sources, levels, contextual applications, and multidimensionality. While these frameworks have advanced understanding, they also reveal limitations, including a tendency to prioritise quantifiable elements, universalise theoretical models, and underplay cultural nuance (Fine, 2001; Fine & Lapavitsas, 2004; Putnam, 2000). As shown in Figure 5a.1, the Tongan concept of *koloa* permeates all dimensions of social capital, offering a culturally grounded means of integrating sources, levels, and contexts to address these gaps.

Figure 5a.1. Literature gaps addressed in the current study



Source: Author

Sources

One major research stream investigates how social capital is generated. Coleman (1988) emphasises trust, norms, and social structures as foundational, while Putnam (2000) focuses on civic engagement and network participation. These perspectives typically support measurable, institutionalised mechanisms over the cultural and relational scaffolding that sustains them. This limitation is especially salient in non-Western contexts, where social capital is deeply embedded in cultural practices and communal relationships.

Linking

Social capital operates at individual, relational, and systemic levels. Lin (2001) and Adler & Kwon (2002) describe how resources are embedded in personal networks and community structures, highlighting relational and systemic dimensions. They use the term 'linking social capital' to refer to these hierarchical ties. Yet linking social capital, particularly in cultural contexts, remains underexplored, leaving a gap in understanding how social capital functions within distinct communal systems.

Contextual Applications

The importance of context is evident in works such as Bourdieu (1986), who examines social capital in the context of economic reproduction, and Fukuyama (1995), who highlights the role of trust in economic systems. However, these approaches often downplay cultural specificity, focusing instead on social capital's utility within broader economic or organisational frameworks. In culturally distinct societies, context plays a more foundational role in shaping the mechanisms and outcomes of social capital.

Multidimensional Nature

The multidimensional nature of social capital has been widely explored in the literature, with scholars like Nahapiet & Ghoshal (1998) identifying its structural, relational, and cognitive dimensions. While these frameworks illustrate how social capital functions across domains, they are often critiqued for limited engagement with culturally specific dynamics. Robinson & Williams (2001), drawing from a Māori perspective in New Zealand, emphasise intangible aspects of social capital such as status, knowledge, opportunities for communication, and cultural participation. These culturally informed perspectives broaden the scope of social capital theory, yet remain geographically and contextually constrained.

Bridging Gaps with Koloa

While existing literature provides valuable insights into the sources, levels, contexts, and multidimensionality of social capital, critical gaps remain in addressing cultural specificity and foundational ontological questions. The overview in Figure 5a.1 positions *koloa* as a unifying and permeating concept that informs these dimensions. By integrating *koloa* across individual, relational, and systemic levels of social capital, the study reveals its potential to bridge theoretical and empirical gaps. Additionally, by situating *koloa* as a cultural lens, the study illuminates the ontological "black box" of social capital, emphasising its cultural scaffolding as foundational to its operation. This contribution advances a more holistic and contextually relevant understanding of social capital.

5a.3. Background – Tongan Social Capital

Tonga, historically known as the "Friendly Islands," is deeply rooted in rich traditions and intricate social networks, yet it has often been overlooked in social capital research. Its unique practices of reciprocity and interconnectedness position it as a hub of relational wealth in Oceania.

In his seminal work *Our Sea of Islands* (1994), Epeli Hau'ofa challenged the perception of Oceania as isolated and fragmented, instead reimagining it as a "sea of islands" interconnected through centuries of voyaging, trade, and cultural exchange. This vision resonates strongly with Tonga's own practices of social capital, exemplified by *fe'uhi'aki*—the neighbourhood and kinship visitations that sustain social ties. As Rev. Dr. Siotame Havea noted in Fusitu'a et al. (2023), *fe'uhi'aki* fosters communal bonds, hones navigational skills, and sustains the intrinsic interconnectedness of Tongan society.

This deeply interwoven social fabric aligns with Hau‘ofa’s depiction of Oceania’s enduring connectivity. Historical records further demonstrate these ties at a regional scale. For instance, King George of Tonga’s military support for Thakombau, King of Fiji, in the nineteenth century significantly influenced Fiji’s internal politics and its eventual colonisation by the British. Such examples illustrate how Tonga’s social capital extended beyond its shores, shaping both regional alliances and wider Pacific histories.

Modern studies continue to trace these evolving connections. Lee (2007), for example, explores how remittances among second-generation transnational migrants sustain relational wealth across borders. These ongoing practices underscore the dynamic yet persistent nature of social capital within Pacific communities.

While the broader literature on Pacific social capital is extensive, focused research on Tonga’s unique manifestations of social capital remains limited. Scholars such as Diedrich et al. (2019), Dorovolomo et al. (2022), and Borofsky (1997) have explored the region’s social dynamics, while studies on kinship (Morton, 1996), *kava* circles (Besnier, 1989; Tecun, 2017), and reciprocity (Evens, 2001) highlight specific communal practices. Although these works may not explicitly frame their findings within social capital theory, they nonetheless reveal the cultural foundations underpinning relational wealth in the Pacific. Among these, Halpern’s (2015) master’s dissertation stands out for its direct examination of Tongan social capital within the diasporic community in California. While valuable, it highlights the need for a more comprehensive exploration of the cultural foundations of social capital within Tonga itself.

Against this backdrop, this study seeks to address gaps in the literature by deepening the understanding of Tongan social capital and its cultural underpinnings. With this context established, the next section examines myths and legends that reveal the ontological "black box" of Tongan culture. These narratives are more than stories: they form the foundation of Tongan social morals, weaving together kinship, tradition, and reciprocity. Through this lens, the cultural axioms underpinning Tonga's social and economic vitality are brought to light.

5a.3.1. Myths and Legends in Traditional Philosophy

In ancient Tongan society, myth created culture, which in turn determined the nature of communal living. Through myth, people came to know the social, political, economic, and psychological means for self-expression (Havea, 2014). This underscores why myths must be read not merely as stories, but as philosophical foundations that encode social capital and communal ethics.

As Farmer (1855, p. 130) observed:

> A great many strange stories were told by the natives respecting Bulotu and their gods. To us, they seem, at first sight, foolish. But we do find here and there a slight trace of knowledge derived from a higher source than man's own…

Myths and legends have long shaped the philosophical foundations of cultures worldwide, underpinning systems of belief and social behaviour (Campbell, 2008; Shynkaruk, 2018; Lévi-Strauss, 1962). In Tonga, they are more than cultural artefacts; they encode values and beliefs that guide social behaviour and resilience (James, 1991).

Colonial observers also noted their relevance. Basil Thomson, in *The Diversions of a Prime Minister* (1894), remarked that myths were embedded in the names of landmarks and places,

securing them in collective memory. On one occasion, he heard a Tongan story that also involved another Pacific island. Later, when he met a man from that island, he asked about the story, and the man confirmed a similar account from his own cultural perspective. For Thomson, this suggested that such narratives carried wider resonance across Oceania, reinforcing their credibility and their role in shaping a shared worldview.

These observations illustrate the role of myths in framing authority, reciprocity, and moral guidance. The following section turns to key Tongan myths that embody these values and demonstrate how they inform the cultural foundations of social capital.

5a.3.2. Key Myths

The Myth of ʻAhoʻeitu (Gifford, 1924, pp. 25–38; Biersack, 1987, p. 49) recounts how ʻAhoʻeitu, son of Tangaloa the sky god and a mortal woman, became the first King of Tonga. Betrayed and killed by his brothers, he was restored to life by his father, who appointed him Tuʻi Tonga and assigned his brothers to serve as ceremonial attendants (*matāpule*), with the eldest placed in a subordinate "second house." The narrative provides a divine sanction for kingship and establishes the hierarchical structure that has continued to define Tongan society, embedding authority, service, and forgiveness as central organising principles.

The Myth of Hikuleʻo (Douaire-Marsaudon, 1996, pp. 156–159) centres on Hikuleʻo, Tangaloa's sister, who is associated with land fertility and prosperity. The ʻInasi ritual, in which first fruits are offered to appease her, emphasises reciprocity and respect for women's elevated roles in Tongan culture, particularly through the concept of *fahu* (paternal sister supremacy).

The Myth of Mauikisikisi – Mischievous Maui (Collocott, 1928, p. 3) contrasts obedience and defiance. Mauikisikisi's reckless disregard for the wisdom of Mauimotu'a serves as a cautionary tale, teaching the value of dedication and harmony with nature, reinforcing the necessity of fulfilling one's responsibilities.

The Myth of Sisimata'ila'a (Gifford, 1924, pp. 114–118) tells the story of the island Felemea, meaning "Abundant-with-possessions." It highlights themes of humility and divine providence, underscoring the belief that wealth and blessings often emerge from humble origins, guided by a benevolent paternal figure.

5a.3.3. Faa'i Afei Koula: The Four Golden Sashes

These myths collectively exemplify the *Faa'i Afei Koula*, or "Four Golden Sashes" of Tongan society:

1. *Respect* – The foundation of hierarchical order and societal harmony.
2. *Reciprocity* – Essential for maintaining balanced relationships and communal unity.
3. *Selfless Commitment* – Emphasising dedication and duty to collective well-being.
4. *Humility* – Highlighted through divine intervention and the blessings that arise from modesty.

Introduced here for the first time, this study adopts *sashes* as a metaphor akin to the Biblical "belt of truth" (Ephesians 6:14), underscoring the intrinsic social interconnectivity of *koloa*. This interpretation reveals the deeper axioms of Tongan social capital, which the following case study will explore through lived activities, processes, and behaviours.

5a.4. Method

This study adopts a retrospective insider ethnographic approach. Ethnography, rooted in anthropology, seeks to illuminate the beliefs, practices, and interactions that shape cultures and societies (Hammersley & Atkinson, 2019), and is well suited to examining the relational dimensions of koloa and Tongan social capital (Emerson et al., 2011). The researcher's involvement in the community activities initially occurred without any intention to conduct research. During participation, however, the potential academic value of the experiences and interactions became apparent, and their possible research significance was noted privately. Following discussion with the lead supervisor, the researcher subsequently disclosed this academic interest to the relevant groups and obtained permission to draw upon material arising from two of the projects. The third project involved observation of publicly occurring activities, including the researcher's family participation on the same basis as other participating families.

The research began as a desk-based study, drawing on policy documents and secondary government data. As the researcher's involvement in three community projects progressed, the potential research value of the activities, interactions, and associated records became apparent. Their subsequent consideration for academic use raised ethical considerations associated with human-participant material and required the reconstruction of relevant project records and the anonymisation of participant identities. A Massey University Low Risk Notification had been completed for the initial scoping stage; it did not constitute approval for the subsequent ethnographic use of material arising from the community projects. The ethical treatment of that material, including community permissions, anonymisation, and limitations on what was included in the thesis, is detailed in Section 5a.4.2.

5a.4.1. Two primary techniques were employed:

1. *Case study approach* – leveraging the researcher's direct involvement in three community projects to generate detailed, context-rich insights.

2. *Triangulated focus group discussions* – used to validate and refine interpretations emerging from the case studies.

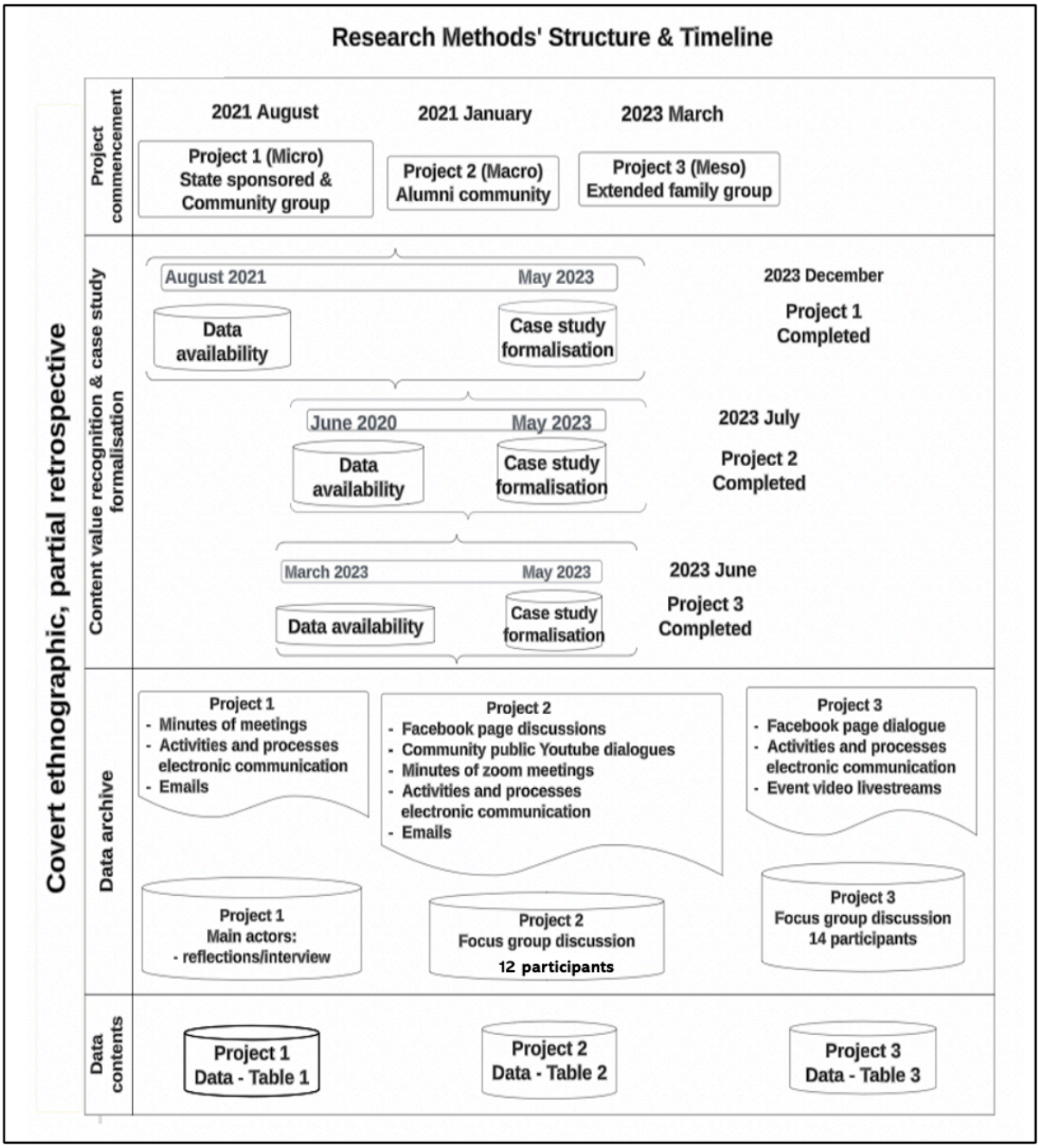
Reflexive analysis was embedded throughout, with the researcher critically assessing how their positionality as both a cultural insider and project leader shaped the interpretation and presentation of findings.

Focus group

Two focus group discussions were conducted. The Project 2 (macro-level) group comprised 12 ex-students who had been directly involved in the project and were selected to reflect a diversity of professional and geographic perspectives. Participants were based across Tonga, New Zealand, and Australia and included individuals in senior professional and leadership roles, including two PhD holders, a lawyer, a nursing school principal, a bank manager, and an agricultural researcher. The Project 3 (meso-level) group comprised 14 representatives from the participating branches of one family. Participants in both groups were recruited by invitation, with guiding questions and discussion agendas provided in advance.

The sessions were video-recorded with the informed consent of participants. The supervisor was present and summarised the discussions, and the researcher subsequently checked these summaries against the video recordings to confirm the interpretations used in the study. Participant identities were anonymised in the analysis and presentation of the material. Figure 5a.2 presents the timeline of the three projects and associated research activities.

Figure 5a.2. Project timeline



Source: Author

5a.4.2. Ethical Considerations

The study's evolution from desk-based research to ethnographic fieldwork required careful attention to ethics. A Massey University Low Risk Notification had been completed for the initial scoping and stakeholder-discussion stage; this did not constitute full Human Ethics

Committee approval. The subsequent consideration for academic use of ethnographic observations arising from the community projects therefore introduced additional ethical considerations. These were addressed through supplementary safeguards informed by institutional and cultural ethical principles:

- *Informed Consent and Permission:* For the two group-based projects, permission for academic use was obtained through culturally appropriate channels, ensuring that participation was voluntary, informed, and respectful of the communal nature of the projects.
- *Anonymisation:* All identifying details were removed or altered during data processing to maintain confidentiality and privacy.
- *Cultural Engagement and Trust:* The researcher's established position within family, community, and cultural networks facilitated trust, enabling richer and more open dialogue. This trust was cultivated over time and sustained through reciprocal relationships rather than single transactional consent moments.
- *Complementarity of Institutional and Community Ethics:* The University's low-risk ethics process provided an institutional framework for the initial scoping stage, while community permissions operated as a separate and important process for the community projects. These permissions were expressed through ongoing relationships, collaboration, and mutual accountability.

These safeguards supported the respectful and careful handling of contributions.

Study's Inclusion in the Doctoral Dissertation

Although this study originated as a desk-based component within the wider research project, opportunities arose during the doctoral journey to incorporate ethnographic observations from three community projects. Because full Human Ethics Committee approval had not been

secured for the ethnographic component, only part of the study is included in the thesis; detailed ethnographic material requiring full Human Ethics Committee approval was excluded.

Its inclusion here reflects strong alignment with the dissertation's overarching objectives, particularly the examination of Tongan social capital through culturally grounded concepts such as *koloa*. The case study offers a distinctive cultural lens that complements the theoretical and analytical discussions elsewhere in the thesis and strengthens the integration of Indigenous perspectives into the overall contribution. While further analysis will be developed in postdoctoral work, its presence in this dissertation ensures that these valuable insights are part of the academic record and contribute meaningfully to the field.

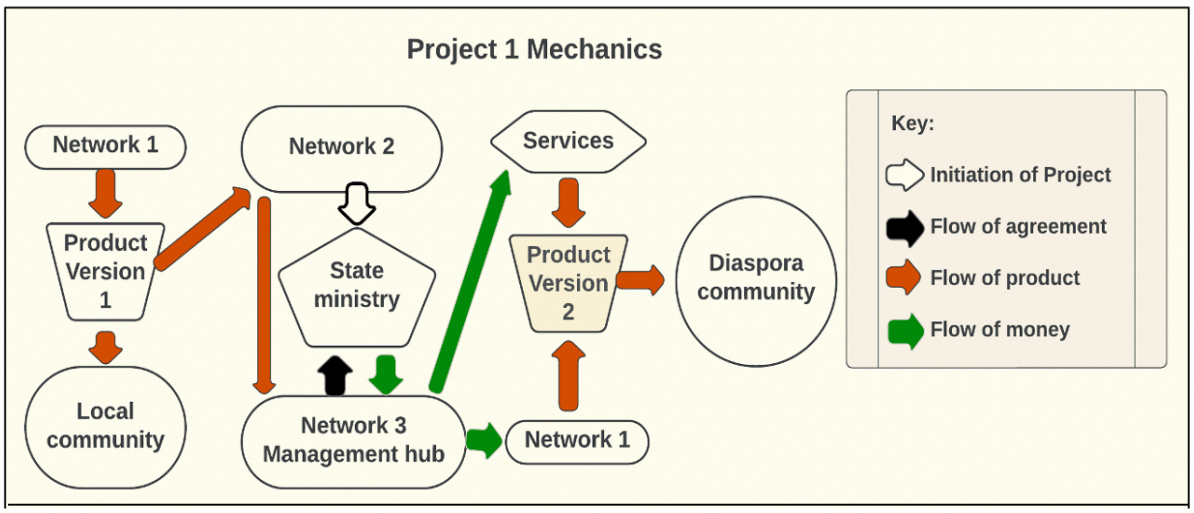
While detailed accounts of the projects are withheld to meet ethical requirements, the following section outlines their scope and context, providing the foundation for the subsequent discussion of findings.

5a.5. Project description and data

5a.5.1. Project 1: Managing State-Funded Project (Micro-Level)

Figure 5a.3 illustrates the mechanics of Project 1. Starting from the top-left corner, members of Network 1 developed an educational product (Product Version 1) designed to support students, particularly those within the Tongan diaspora. Network 2, acting as a bridge between Networks 1 and 3, sought funding to adapt the product for broader use. A formal agreement with a state funding body was secured, with Network 3 introduced to oversee project formalisation and completion.

Figure 5a.3. Project 1 Mechanics



Source: Author

This figure depicts the flow of agreements, product development stages, and financial transactions among the networks. Working with the original developers, Network 3 produced an updated version (Product Version 2), culminating in a formal launch event. Reporting requirements included interim and final reports to the state funding body, prepared and submitted by Network 3.

This project began in August 2021 and was completed in December 2023, experiencing a significant delay from its originally planned completion in 2022. Logistical challenges, as well as successes in coordinating stakeholders across multiple countries, provided valuable insights for the study, particularly regarding the management team and the 'koloa' – the patience, perseverance, and commitment they brought to the project.

Table 5a.1. Project 1 data structure

Project 1	**Data collected from commencement date – to date of writing**		
Participants	***Communication channel***	***Communication content***	***Analysis reference***
Principal Actors	*(n = number of items)*	*Samples only***	
A_1, B_1, C_1 D_1, E_1, F_1, G_1 H_1, I_1, J_1, K_1	MmoMs* (n = >14) Emails (n = >300) Messenger (n ≈ 50) Observation Reflections from A_1 & C_1. Reflexivity by B_1	Exhibit 1_1 Exhibit 2_1 Exhibit 3_1 Exhibit 4_1	Delay indications Email to revive project Communication samples Narrative Reflection & reflexivity details
Other Actors			
L_1, M1, N1	Emails:	Exhibit 5_1	Ministry commendations
Additional Actors			
O1, P1, Q1, R1, S1 T1.	Emails: MoM (Zoom meeting)	Exhibit 6_1 Exhibit 7_1 Exhibit 8_1	
* MmoMs = monthly minutes of meetings. ** Pseudonymised samples will be provided. The archived record remains in the source format of the data.			

Source: Author

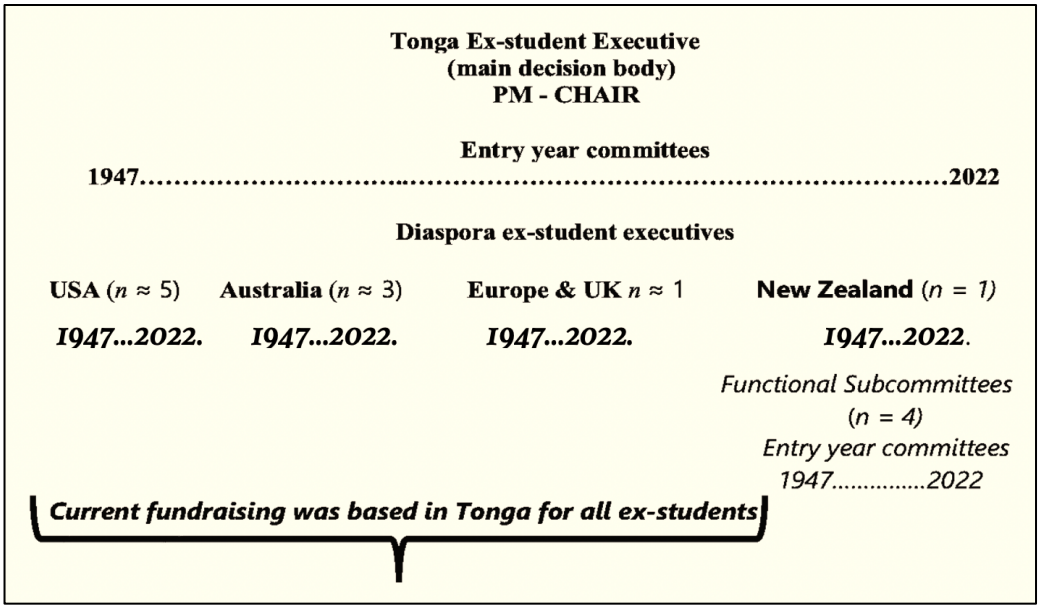
5a.5.2. Project 2: High School Library Reconstruction (Macro-Level)

Established in 1947 to educate Tonga's top students, a prominent government high school sustained severe fire damage in 2000. While most facilities were rebuilt in subsequent years, the library and school hall remained incomplete for over two decades. In 2021, the Prime Minister of Tonga, working with the ex-student board, launched a national and diaspora fundraising campaign to complete these key buildings.

The initiative combined regional fundraising concerts in Tonga with contributions from overseas alumni networks. Ex-students and their families formed regional and diaspora-based groups to coordinate events, gather donations, and prepare for the facilities' reopening celebrations. Figure 5a.4 maps the relationships between family groups, diaspora committees and coordinating bodies involved in the project.

The research examines communication across these interconnected networks, from household levels coordination to national and international organising committees. Table 5a.2 summarises the data collected, including social media interactions, livestreamed fundraising events, quarterly meeting minutes, and a focus group discussion with ex-students. All participant data were pseudonymised for analysis, with original records retained in their source formats.

Figure 5a.4. Project 2 Participants' networks



Source: Author

Table 5a.2. Project 2 data structure

Project 2	**Data collected from commencement date – to completion date**		
Participants	***Communication channel***	***Communication content***	***Analysis reference***
Principal Actors	*(n = number of items)*	*Samples only***	
Family groups Regional concerts Ex-students' sub-committee Researcher	Messenger (n = 30) Social media group Livestream videos QmoMs* (n = 10) Observation	Exhibit 12 Exhibit $1a_2$ Exhibit 22 Exhibit 32 Exhibit 42	Ex-student household communication Fundraising video links Excerpt from minutes Narrative
Other Actors			
All ex-students	Facebook pages	Exhibit 52	Link to Facebook pages
Focus group discussion			

Researcher, Supervisor 12 ex-students	Focus group discussion (FGD)	Exhibit 62 (Video recording)	FGD images FGD comments
* QmoMs = Quarterly minutes of meeting ** Pseudonymised samples will be provided. The archived record remains in the source format of the data.			

Source: Author

5a.5.3. Project 3: School Dormitory Reconstruction (Meso-Level)

Project 3 examines the fundraising efforts of the Kukuvalu region's ex-student committee, which contributed to a nationwide campaign to reconstruct a historic school dormitory. This meso-level case highlights the interplay of cultural values, relational networks, and collective action in achieving a shared community goal.

The Kukuvalu contribution was scheduled during the final phase of the national fundraising programme, fostering both collaboration and friendly competition among regions. These efforts were shaped by the legacy of *Family X*, descendants of the school's first Dux, whose story holds enduring cultural and historical resonance within the community.

The national campaign commenced in the village of Touhuni, renowned for its vibrant cultural performances and ceremonial use of *koloa* (traditional valuables). Their highly theatrical displays of pride and sentiment set a benchmark for other regions. In contrast, the Kukuvalu region, valued for its methodical and measured approach, anchored its activities in the historical ties to *Family X.*

Family X played a central role in mobilising participation across the Kukuvalu region, using social media and family networks to coordinate contributions. Multiple rounds of fundraising events were organised, culminating in a large combined family concert that raised over TOP$100,000. This achievement was celebrated regionally, with the family given the honour

of inaugurating the Kukuvalu concert and leading a church service during the associated festivities.

Table 5a.3. Project 3 data structure

Project 3 Data collected from commencement date – to completion date			
Participants	***Communication channel***	***Communication content***	***Analysis reference***
Principal Actors	*(n = number of items)*	*Samples only**	
Extended family steering committee: A_3, B_3, C_3, D_3, E_3, F_3. Steering committee spoke persons: G_3	Messenger (*n* = >40) Facebook page (*n* = >100) Video recordings (*n* = 6) Observation	Exhibit 1_3 Exhibit 2_3 Exhibit 3_3	Project family meeting Project announcement & targets Fundraising video snapshots
Other Actors			
All ex-students' leaders Regional ex-students' leaders	Video recordings (*n* = 6) Messenger (*n* = >30)	Exhibit 4_3 Exhibit 5_3	Regional concert snapshots (x3) Com. with regional spokesperson
Focus group discussion			
Researcher Supervisor 14 participants	Video recordings Observation**	Exhibit 6_3 Exhibit 7_3	Image of video archived. Social meetings at other times
* Pseudonymised samples will be provided. The archived record remains in the source format of the data. ** Observation based on insightful nuances during all communications.			

Triangulation activities

Primary data were drawn from group communications across three different projects. To enhance the reliability and validity of the findings, additional methods were employed:

- *Group Discussions* – Projects 2 and 3 conducted structured discussions to confirm and validate the findings.
- *Reflections and Interviews* – Project 1, reflections and interviews were conducted with two key members to provide deeper insights and contextual understanding. No additional details regarding this activity will be included.

This triangulation provided a multi-perspective view of each project, reinforcing the robustness and credibility of the overall analysis.

Focus group discussion

Project 2: Key Themes

While this study does not present empirical findings, the themes that emerged from the broader discussion offer valuable insights into the dynamics of fundraising efforts. These themes illustrate the complex interplay between identity, social cohesion, and collective action in resource mobilisation.

Family Pride and Legacy – Fundraising efforts are often rooted in a shared sense of history and collective memory. A key figure or symbolic ancestor may serve as a unifying force, bringing together different branches of a group or family. Such initiatives not only honour past achievements but also reinforce a sense of belonging and intergenerational continuity.

Intersectionality and Inclusion – The process of mobilising resources often transcends individual identities, fostering connections across diverse religious, educational, and cultural backgrounds. These efforts can serve as a platform for strengthening relationships, particularly among extended family members and in-laws, who may take on active roles in advancing shared goals.

Sacrifice and Reciprocity – A strong sense of collective responsibility often shapes the way financial contributions are perceived. Rather than being seen as isolated transactions, contributions may be framed as reciprocal acts—expressions of commitment to a shared vision.

The iterative and sustained nature of fundraising can reinforce cultural values of mutual support and long-term investment in a common cause.

Project 3: Key Themes

Project 3 provides additional insights into the intersection of cultural values, reciprocity, and the social dynamics of collective action. The themes outlined here reflect the broader importance of collaborative engagement and mutual support in achieving shared goals. Without presenting specific findings, this discussion offers a theoretical lens on how community-driven initiatives are shaped by cultural frameworks and relational expectations.

Duty to Legacy – A shared sense of obligation to honour significant historical figures often serves as a source of pride and unity, strengthening collective identity across different branches of a family or community.

Family Unity – Intergenerational projects can foster deeper relationships, with extended family members, including in-laws, playing a key role in reinforcing social bonds and collaboration.

Intrinsic Rewards – Contributions to collective efforts are frequently associated with personal fulfilment and a strengthened sense of belonging and purpose within a community.

Cultural and Relational Dynamics – Core cultural values, such as respect, selfless commitment, reciprocity, and humility, often shape behaviours and contribute to collective success.

Collectivism – In many societies, collectivist values emphasise communal action as a driving force in achieving shared goals, sometimes in contrast to more individualistic approaches observed in other cultural contexts.

5a.6. Discussion

This study set out to investigate the cultural core underpinning social capital in Tonga, what the study conceptualises as its *ontological black box.* While dominant social capital theories emphasise networks, trust, and reciprocity, they often overlook the deeper cultural logics that shape and sustain these relationships. This research responds to that gap by revealing the philosophical and ethical foundations that regulate social capital within a Tongan context.

The Ontological Black Box represents these deeply embedded but under-theorised cultural mechanisms that inform how relationships are built, maintained, and reinforced over time. While social capital is often measured in terms of economic or social utility, this study demonstrates that its foundations lie in a set of culturally specific ethical principles. These principles are encoded in Tongan myths and traditions, where they are most explicitly articulated through the Faa‘i afei koula (Four Golden Sashes) – mamahi‘i me‘a (selfless commitment), fakatōkilalo (humility), tauhi vā (relational maintenance), and reciprocity. These values serve as the active forces that govern social relationships, ensuring balance, cooperation, and collective well-being.

However, understanding the Ontological Black Box requires more than recognising its ethical base – it necessitates an examination of how these embedded values are enacted, sustained, and transferred across generations. This study identifies koloa as a key structuring mechanism that materialises these foundational philosophies in everyday life. While the Ontological Black Box

provides the hidden logic that regulates social capital, koloa serves as its operational framework, encompassing the tangible and intangible assets that reinforce these cultural principles. Specifically, koloa is expressed through:

- *Intellectual koloa* – The knowledge, wisdom, and philosophies embedded in oral traditions, myths, and contemporary cultural practices.
- *Human koloa* – The embodiment and exercise of cultural values, particularly through the knowledge and practice of the Four Golden Sashes (*Faa'i afei Koula*).
- *Real koloa* – Land, natural resources, and ancestral spaces that hold cultural, historical, and economic significance in sustaining community well-being.
- *Intrinsic koloa* – The spiritual and moral wealth embedded in collective identity, family honour, and social responsibility.
- *Material koloa* – The physical expressions of cultural wealth, including traditional goods, ceremonial gifts, and economic resources exchanged in social relationships.

Thus, the findings of this study affirm that the *Ontological Black Box* of social capital is not an abstract or static concept – it is actively sustained and realised through *dynamic cultural systems.* The philosophical wisdom embedded in Tongan traditions (*the black box*) is transformed into lived social reality through structuring mechanisms such as koloa, which ensures that relational wealth is not only maintained but continuously adapted to evolving social and economic contexts.

5a.6.1. Theoretical Contributions

The study makes significant contributions to the existing body of social capital literature by addressing gaps and extending the theoretical framework in culturally specific ways.

Illuminating the Ontological Black Box – Traditional social capital theory often economises or universalises the concept, focusing on quantifiable elements such as trust and networks. By conceptualising social capital through the *Ontological Black Box*, this study uncovered the concealed cultural foundations that sustain and invigorate social capital in Tonga. The emergence of koloa as a structuring mechanism further demonstrates how these cultural foundations are operationalised in practice.

Cultural Specificity in Social Capital – The findings highlight the importance of grounding social capital theories in cultural contexts. For instance, the intersectionality observed in Project 3's focus group discussions reflects how familial pride and legacy intersect with collective cultural values to drive community action. This contextualised approach addresses critiques such as Fine's (2004), which highlight the need to move beyond universalised frameworks.

A Framework for Relational Dynamics – This study refines the understanding of relational mechanisms within social capital theory by demonstrating how tauhi vā (relational maintenance) and mamahi‘i me‘a (selfless commitment) function as dynamic regulators of social cohesion. Rather than static cultural values, these mechanisms actively sustain collective cooperation over time, reinforcing the structural balance within the social capital system.

Practical Implications

Community Development and Diaspora Engagement – The findings underscore how deeply embedded cultural values, rooted in the *Ontological Black Box*, mobilise resources and sustain long-term initiatives. The role of koloa as a structuring mechanism within these processes further demonstrates how Tongan communities operationalise relational wealth. The study

highlights the role of social media and digital platforms in strengthening traditional networks, providing a blueprint for enhancing diaspora engagement.

Policy and Leadership – The findings emphasise the value of culturally informed leadership and inclusive decision-making processes in achieving collective goals. Leaders in both local and national contexts can draw on these insights to foster resilience and community cohesion.
Economic Security in Collectivism – The study illustrates how collectivism provides economic security and relational strength, challenging the individualistic approaches often emphasised in Western development paradigms.

5a.7. Conclusion

This study has demonstrated the enduring relevance of cultural values in shaping social capital, offering both theoretical and practical contributions to the field. By exploring the Tongan concept of *koloa* through three ethnographic case studies, the research illuminated the relational wealth and cultural frameworks that sustain communal efforts. The findings emphasise the importance of cultural specificity in social capital theory, addressing gaps in the literature and advancing a more nuanced understanding of its ontological foundations.
The contributions are threefold:

1. *Theoretical Advancement* – By positioning the ontological black box as a foundational framework, this study reveals the cultural core of social capital. The identification of *koloa* as a structuring system further extends this understanding, offering a culturally grounded lens for analysing its practical significance.

2. *Practical Relevance* – The case studies provide tangible examples of how cultural values drive collective action, offering insights for policymakers, community leaders, and diaspora organisations.
3. *Broader Implications* – The findings affirm the transformative potential of cultural capital in fostering resilience, cooperation, and SD, both within Tonga and across the Pacific.

As Tonga and its diaspora navigate the pressures and opportunities of globalisation, the lessons drawn from these projects underscore the enduring power of relational wealth to inspire, unite, and transform communities. By embedding cultural values into the theory and practice of social capital, this research offers a model for more contextually grounded approaches to community development.

Limitations & Future Research

While robust within its context, this study has several limitations:

- *Cultural Context* – The framework is rooted in Tongan culture; its application elsewhere may require adaptation.
- *Qualitative Focus* – As an ethnographic study, insights are interpretive and shaped by the researcher's positionality, though reflexivity was applied to ensure rigour.
- *Case Study Basis* – The three case studies illustrate key themes but are not intended to represent all Tongan or Pacific experiences.
- *Diaspora Scope* – While diaspora engagement is discussed, detailed comparative analysis between local and transnational contexts was beyond the present scope.

Future work could test the ontological black box framework in other Pacific and Indigenous contexts to assess its broader applicability. Developing quantitative tools to measure the role of *koloa* within social capital systems would allow for stronger empirical validation.

Longitudinal studies could track how values such as *tauhi vā* and *mamahi'i me'a* evolve over time in response to social and economic change, while transnational research could examine how *koloa* functions in diaspora networks and whether migration influences the sustainability of Tongan relational wealth. Pursuing such extensions through interdisciplinary approaches spanning anthropology, sociology, and development economics would deepen understanding of how cultural wealth and resilience operate across diverse social capital systems.

Transition to Chapter 6

Chapter 5 extended the "Matters Arising" trajectory of this thesis, exploring concepts that emerged unexpectedly but proved central to understanding SD in Tonga. By examining the relationships between SDG 3 (Good Health and Wellbeing), social capital, and socioeconomic metabolism, it showed how nested relationships operate within SD frameworks. The Matryoshka dolls analogy highlighted these layers, demonstrating how targeted SDG outcomes, cultural values, and material systems intersect within policy-relevant contexts.

Chapter 4, which applied the EW-MFA, provided a proven approach for informing SDG-related policy. The insights from Chapter 5, while distinct, indirectly complement this foundation by underscoring the importance of multilevel frameworks that can guide sustainable policy initiatives in Pacific SIDS.

Chapter 6 now builds upon these insights to introduce an Indigenous Triple Helix Model. The focus is on establishing institutional foundations that support sustainable transition strategies rooted in Indigenous values. It argues that without cultural and contextual adaptation, traditional Triple Helix models are unlikely to thrive; instead, a locally grounded approach offers a stronger pathway to meaningful SD in Pacific SIDS.

CHAPTER 6

Indigenous Resilience & Self-determination for Sustainable Transition: A Pacific SIDS model

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Foreword

Chapter 6 presents the final paper prepared for peer-reviewed publication, addressing Objective 3 of this thesis. It introduces the Indigenous Triple Helix (I-TH) model as an alternative framework to guide sustainable development transitions in Pacific SIDS. Unlike the conventional Triple Helix (TH), which explains innovation through institutional collaboration between government, universities, and industry, the I-TH is rooted in Indigenous resilience and human empowerment, emphasising spiritual authority, kinship-based land stewardship, and

heritage preservation. Together, these elements provide a culturally grounded foundation for sustainability that inherently requires self-determination and community-driven governance.

The I-TH draws directly from the findings of Chapters 2 to 5. Chapters 2 and 4 established empirical benchmarks of sustainable development; Chapter 3 articulated Indigenous pillars of sustainability; and Chapter 5 demonstrated how nested social and material systems shape community wellbeing. Building on these insights, this chapter proposes the I-TH as a foundational framework for Indigenous sustainable innovation.

The chapter is organised into four sections. Following the introduction, which outlines the model's structure, Section 2 presents a comprehensive literature review, Section 3 explicates the model in detail, and Section 4 offers concluding reflections.

By advancing the I-TH, Chapter 6 establishes a culturally grounded framework for re-aligning Pacific SIDS' transition strategies with the SDGs while safeguarding self-determination. It directly addresses the central research question: *Can the Circular Economy advance Pacific SIDS' SDG and NDC targets while maintaining self-determination?*

Abstract

This paper introduces the Indigenous Triple Helix (I-TH) model as a culturally grounded framework for guiding sustainable development transitions in Pacific SIDS. Departing from the conventional Triple Helix, which frames innovation in industrialised nations through collaboration between government, universities, and industry, the I-TH offers an alternative foundation rooted in Indigenous epistemologies, ontologies, and social structures.

Focusing on Tonga, the study employs an interdisciplinary approach, integrating critical discourse analysis, development theory, and ethnographic observation to examine how externally imposed innovations often conflict with Indigenous systems of knowledge production, environmental stewardship, and relational governance.

The I-TH redefines the drivers of innovation in Pacific SIDS, positioning God (spiritual authority), People/Land (kinship-based stewardship of resources), and Heritage (intergenerational knowledge transmission) at its core. By embedding innovation within Indigenous values, the I-TH provides an explanatory framework for why externally designed policies and technologies often fail to achieve lasting success in the Pacific.

The paper concludes by positioning the I-TH as a transformative model for advancing Indigenous innovation, self-determined development pathways, and culturally aligned sustainability strategies.

6.1. Introduction

6.1.1. Part of a wider study

This chapter is the third in a series of studies exploring the concept of Circular Economy (CE) as a sustainable development approach for Pacific SIDS. The series began with a CE stocktake of Samoa, Tonga, and the Cook Islands (Vea-Simpson, 2024), followed by the application of a CE measurement tool: EW-MFA. Although the EW-MFA was applied to Tonga as a single-country study, it establishes a methodological and empirical baseline for comparative regional research. Applying the same accounting framework across additional Pacific SIDS would enable comparison of material-flow patterns, resource dependencies, and circularity conditions, while allowing country-specific differences to remain visible.

This current study focuses on identifying the unique factors contributing to Pacific SIDS resilience, with the aim of supporting the achievement of SDGs. It introduces a novel model that foregrounds Indigenous resilience, grounded in cultural–environmental ontologies and stewardship-based epistemologies, while ensuring the preservation of heritage for future generations. The Indigenous Triple Helix (I-TH) model, conceptualised as *God, People/Land, Heritage*, is derived from Tonga's motto – *God and Tonga are my Heritage* – which embodied Tonga's nineteenth-century foreign policy and is enshrined in its Coat of Arms.

The first study, a stocktake of CE practices, revealed key cultural differences between Samoa, the Cook Islands, and Tonga. It highlighted that Samoa and the Cook Islands had progressed in sustainable development by utilising Indigenous utilities embedded in their cultural systems, while Tonga was identified as requiring deeper investigation due to its regression in sustainable development (Vea-Simpson, 2024, pp. 155–156). Consequently, this study focuses on Tonga to add further value to the series. Furthermore, Tonga has long intrigued political observers and anthropological scholars due to its complex and unique characteristics. As Thomson (1894, p. 291) noted: *This tiny Kingdom… boasted so complicated a social polity that its history, as an illustration of the growth of human institutions, is worthy of study for its own sake.*

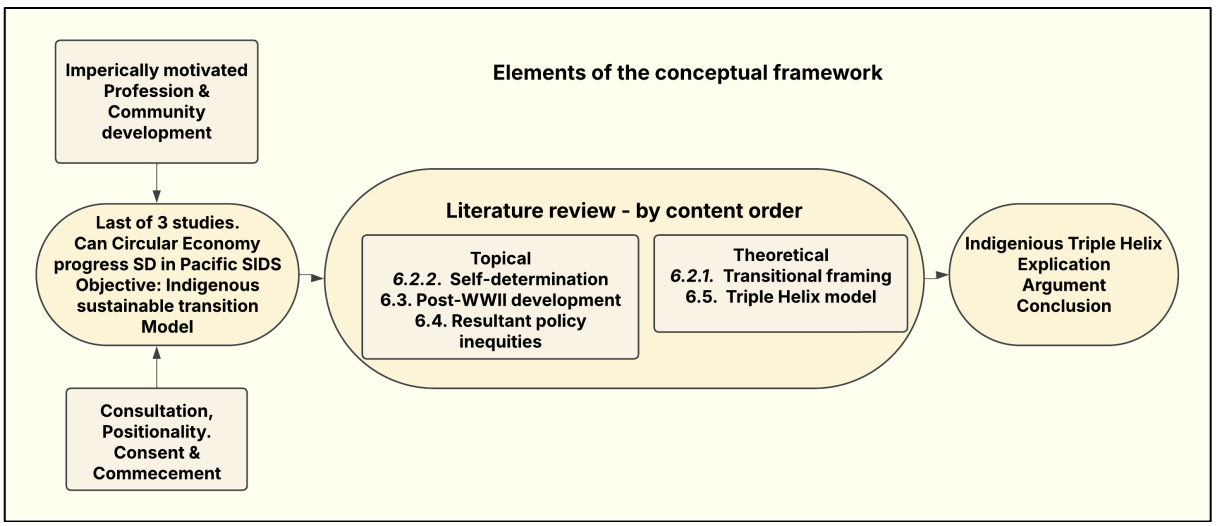
Tonga's maritime history further underscores its significance. As Kirch (2015, p. 103) observed:

> The Tongans had once been famed seafarers and navigators… They had been masters of what has been called the 'Tongan Maritime Empire,' ruling from the royal seat of the Tu'i Tonga or sacred kings at Mu'a on Tongatapu.

These historical and cultural dynamics, coupled with Tonga's critical environmental challenges, accentuate the importance of incorporating Indigenous perspectives into development models. This approach can serve as a blueprint for other Pacific nations to adapt to their specific ecological and cultural contexts.

Accordingly, the broader field of transitional sustainable development studies is inherently multidisciplinary, and this paper aligns with that tradition. Guided by Ravitch and Riggan's (2017, p. 9) *Elements of a Conceptual Framework* (Figure 6.1), the study is shaped by personal interests and goals while acknowledging positionality. The conceptualisation process begins with a defined preliminary goal, followed by a review of both topical and theoretical literature. This ultimately leads to a refined version of the proposed model. The theoretical contribution is then explicated, rationalised, and concluded. Figure 6.1 illustrates how these elements informed the development of the I-TH model.

Figure 6.1. Conceptual framework for the I-TH



Source: Author's conceptualisation adapted from Ravitch & Riggan (2017, p.9)

6.1.2. Model Theorising

Prevailing sustainability solutions are largely designed for industrialised contexts (Blicharska et al., 2021, p. 1; Hughes & Paterson, 2020, p. 10). When applied to Pacific SIDS (Ma'u, 2019), which lack comparable infrastructure (Terauds, 2021, p. 25), these models often result in inequity, economic entrapment, and environmental indifference rather than fostering sustainability (Vea-Simpson, 2024, p. 156). From a social construct perspective, Krossa's (2013) conceptualisation of society provides an important example. Her framework seeks to explain societal structures on a global scale, resembling expansionist economic models that inadequately account for the ecological and cultural realities of local contexts (Spivak, 1988).

The vulnerabilities of human societies to externally imposed restructuring can be compared to the social conduct of whales. Whales, reliant on stable ecosystems and complex social bonds (Gero, 2013; Filatova et al., 2013), face existential threats when their natural and social orders are disrupted. Similarly, Indigenous human communities experience erosion of their ways of life when external forces dismantle their societies under the guise of global "readjustments" (Hochberg, 2004; Holton, 2000).

In theory-building, Shepherd and Suddaby (2017) emphasise the importance of developing theories that advance knowledge, while Alvesson (2011) encourages scholars to challenge underlying assumptions rather than merely addressing gaps in the literature. Corley and Gioia's (2011) concept of *prescience* advocates a shift in management theorising towards future-oriented insights rather than reliance on past data. Their approach was influenced by the significant epistemological gap between practitioners and scholars. Additionally, Kovács-Kószó (2020), in reviewing Ravitch and Riggan, highlights the importance of framing

conceptual frameworks as living instruments that evolve alongside the study, facilitating deeper insights into sustainability in Pacific SIDS.

Accordingly, the present work treats the conceptual model as a dynamic tool for guiding research (Ravitch & Riggan, 2017). By utilising the I-TH model, God, People/Land, and Heritage, this paper presents a holistic framework that captures the interdependence of spiritual, social, and environmental elements. Rooted in the ontological and epistemological standpoint of Pacific peoples (Naepi, 2019, p. 1), the I-TH represents a paradigm shift away from industrial and economistic views of sustainability (Hau‘ofa, 2008, p. 30) towards a more interconnected and holistic approach (Nabobo-Baba, 2008). It aligns with the phenomenology of Pacific SIDS (Merleau-Ponty, 2010), emphasising the inherent relationality between people, land, and environment, both in thought and practice.

6.1.3. Structure of the study

The remainder of this paper is organised into three sections. Section 2 provides an extensive literature review, guided by Ravitch and Riggan’s (2017, p. 9) conceptual framework approach. It begins by critically examining transitional sustainability as an ill-fitting model for the Pacific, raising concerns about the validity of self-determination within this context. This is followed by a discussion of self-determination from both conceptual and ideational perspectives, exploring its theoretical foundations and implications.

Recognising the broader historical context, the literature review then traces the post–World War II development pathway, examining how prevailing global frameworks evolved and influenced Pacific nations. Within this trajectory, the review identifies policies that shaped socioeconomic conditions, reinforcing structural inequities and economic entrapment. These

policies also contributed to environmental indifference, as populations facing economic pressures prioritised immediate survival over long-term sustainability.

The literature review concludes with an exploration of the TH model of University–Industry–Government collaboration (Etzkowitz & Leydesdorff, 1998), which provides a theoretical foundation for the Indigenous I-TH model proposed in this study. Following the review, Section 3 explicates the I-TH model - God, People/Land, and Heritage, and demonstrates its conceptual and practical relevance to Pacific SIDS. Section 4 then concludes the paper by summarising key findings and discussing their broader implications for sustainable development transitions in the Pacific.

6.2. Literature review

6.2.1. Transitional sustainable framing

Sustainable development has been defined as the "reconciliation of society's developmental goals with the planet's environmental limits over the long term" (Boons & McMeekin, 2019, p. 299). This reconciliation highlights the vast gap between human welfare and environmental protection, fostering diverse approaches to sustainable innovation that encompass economic, technological, and societal perspectives.

Socio-technical transition research (ie. work on how societies adopt and spread new technologies and practices) emerged in the early 2000s (Geels, 2019, p. 187). A core approach is the Multi-Level Perspective (MLP), which explains change across three levels: slow-changing macro-level factors ('landscape'), dominant systems and institutions ('regimes'), and protected spaces for trialling new ideas ('niches'). The version presented by Ceschin and

Gaziulusoy (2019, p. 126) illustrates how innovations developed in niche contexts can influence and eventually reshape dominant regimes, especially when external pressures create openings for change. This formulation portrays transition as a directional, externally steered process that does not align with the relational and place-based governance systems of Indigenous societies.

Geels (2011) later responded to critiques of the MLP by refining its features through the lens of social-science ontologies, thereby reinforcing its relevance. However, transitional sustainability models such as the MLP and Krossa's (2013) global societal framework still struggle to capture the specific ecological, economic and cultural contexts of Indigenous societies in Pacific SIDS. This limitation is evident in Tonga's socio-technical struggle with energy-transition innovations over the past decade, where externally supported niche projects have frequently disrupted rather than strengthened local resilience and community autonomy (Vea-Simpson, 2024, p. 151). Given the limitations of external transitional models, a more contextually grounded approach must begin with self-determination, the foundational principle for sustaining and managing resilience in Indigenous societies (Parsons et al., 2021; Spencer et al., 2020). This principle is intrinsically linked to ecological and cultural realities, offering an internally grounded framework that balances societal development aspirations with planetary environmental limits (Mawyer & Jacka, 2018). Recent scholarship increasingly highlights this perspective, recognising Indigenous-led governance and self-determination as critical for achieving both environmental sustainability and cultural continuity in the region (Maguire & McGee, 2017; Taylor, 2024).

Achieving this balance may require significant trade-offs between human progress and environmental preservation. Therefore, this paper proposes an alternative approach that

reconciles these competing demands by embedding sustainability within Indigenous principles, with self-determination at its core.

Self-determination will be explored in the next section, given its essential role in this study.

6.2.2. Self-determination

Self-determination – a perspective

Self-determination emerged as a cornerstone of international justice and peace following World War II, enshrined in the United Nations Charter (1945). The Charter underscores the development of friendly relations based on the "equal rights and self-determination of peoples" as essential to strengthening universal peace. This principle was further reinforced by the UN General Assembly's (1960) Declaration on the Granting of Independence to Colonial Countries and Peoples, which affirmed the right of all peoples to determine their political status and pursue economic, social, and cultural development. However, despite its foundational role in international law, self-determination has largely remained a principle rather than a substantive authority, subject to interpretation and shaped by the shifting priorities of global power structures (Saul, 2011; Quane, 1998; Cristescu, 1981).

Initially heralded as a mechanism for decolonisation, self-determination's ambiguous legal status has resulted in inconsistent application. Scholars such as Sparks (2023) and Summers (2019) argue that its reliance on territorial sovereignty often marginalises cultural and ecological governance systems, which are vital to Indigenous societies. Similarly, Umozurike (1972) and Ezetah (1997) highlight that post-colonial legal systems have struggled to protect smaller or marginalised states, leaving them vulnerable to external pressures and global mandates. These vulnerabilities are particularly pronounced in Pacific SIDS, where economic

dependencies and international agreements, for example Pacific Agreement on Closer Economic Relations **(**PACER Plus, 2020), have further eroded autonomy.

These limitations expose a critical gap in existing development frameworks: the systematic marginalisation of sustainable and resilient Indigenous knowledge systems**.** This gap underscores the urgent need to explore approaches that prioritise local agency while aligning with the ecological and cultural realities of Pacific SIDS. By failing to integrate these systems, current frameworks not only reinforce vulnerabilities but also undermine the potential for sustainable development that is genuinely rooted in the lived experiences and strengths of Pacific communities**.**

6.2.3. Self-Determination – An Ideation

Kissinger (2014) observed that the modern world order was shaped through the Peace of Westphalia, which ended the Thirty Years' War (1618–1648). This treaty established the principle of state sovereignty, granting each state authority over its own territory while affirming non-interference in internal affairs. However, Kissinger notes that this system was rooted in pragmatic concerns rather than universal moral foundations, emphasising its function as a mechanism to contain conflict rather than an ethical construct.

In a conversation with then-President Harry S. Truman, Kissinger recounts Truman's pride in having "totally defeated our enemies and then brought them back to the community of nations" (p. 9). He further reflects that, at the time of its creation, much of the world remained unaware of the Westphalian order. That the system was devised rather than organically emerging from shared moral principles reinforces its functional rather than normative origins.

This perspective sets the stage for Philpott's (1995) argument that, while sovereignty provided the foundation for the modern state system, its moral ambiguity has allowed contemporary global governance to redefine its principles. Ideas such as democracy and human rights, once peripheral to sovereignty, have increasingly been used to justify interventions in the internal affairs of states. Thus, what was initially a practical framework for stability has evolved into a contested space, where competing interpretations of sovereignty and human rights shape the boundaries of self-determination. Philpott (2001) argues that the very ideas which historically legitimised the sovereign state including democracy and human rights, can also underpin arguments for limiting or reshaping sovereignty today. He suggests that since ideas were central to creating the sovereign state system, they may equally drive contemporary pressures that erode or transform it. This underscores the contingent nature of sovereignty and self-determination, both of which remain subject to evolving global priorities.

Moyn (2010) refocuses this critique by examining the hydraulic relationship between human rights and self-determination, where the rise of one often comes at the expense of the other. Situating self-determination within the context of decolonisation, Moyn contends that it was largely grassroots driven, whereas human rights lacked a comparable mobilisation. While Moyn's analysis highlights tensions within modern governance, critics such as Anghie (2004), Cheah (2006), and Benhabib (2011) challenge his framing. They argue that while universal narratives like human rights may conflict with localised autonomy, they do not inherently diminish it.

Mendelsohn (2012) introduces an alternative conceptualisation, arguing that theological frameworks of world order merit recognition because religions derive their significance through human agency. From the perspective of competing frameworks for organising the

world, Mendelsohn highlights the role of "transitional actors" such as al-Qaeda (AQ) and Hizb ut-Tahrir (HT) in drawing attention to critical features of international relations, particularly the foundational principles of international society, such as states' rights and their associated responsibilities. A key question emerges: What are the attitudes of these ideological groups towards the institutions of international society, and could those attitudes be harnessed to pursue constructive aims? Although AQ and HT wield minimal direct influence on global affairs, their actions and ideologies have compelled the world to allocate extraordinary resources, underscoring the significance of even marginal actors in shaping international discourse.

The ideation approach to this topic, while seemingly sporadic, finds grounding in historical context. Sofer (2009) identifies the Peace of Westphalia (1648) as a pivotal moment shaping international relations theory, serving as a cornerstone for understanding sovereignty and state systems. More recently, in 1989, the concept of a New World Order emerged, purportedly supplanting the Westphalian paradigm. Additionally, Schmidt (2011, p. 601), citing Krasner (1993), notes that international relations scholarship frequently invokes Westphalia as a symbolic reference point for analysing global systems. However, Schmidt also highlights the conceptual challenges of treating the Westphalian system as the definitive achievement of state sovereignty and the formation of an international community.

This critique is further explored in contemporary scholarship. Massimi (2023) examines Kant's cosmopolitan right, analysing its metaphysical underpinnings and their implications for international law and universal human rights. Similarly, Aalberts and Werner (2016) discuss how the concept of sovereignty continues to evolve, particularly in relation to the global commons and the legal framing of metaphysical territories. Aral and d'Aspremont (2024)

extend this discussion, emphasising the universality of international law as it grapples with the complexities of territoriality, rights, and globalisation.

These perspectives expose a critical and deeply problematic dimension of self-determination: the persistent tensions between territorial claims, conflict, and competing rights. As globalisation accelerates the shift towards a borderless reality, international law faces mounting challenges in regulating metaphysical territories and addressing the universal rights of humankind. This body of literature underscores the evolving nature of sovereignty and self-determination, emphasising the need to integrate diverse frameworks into global governance. For Pacific SIDS, this recognition validates Indigenous knowledge systems as essential to achieving contextually grounded and globally relevant SDGs, reaffirming their custodial role in ecological and cultural resilience.

6.3. Post-World War II development.

The post-World War II era marked a pivotal moment in the evolution of international governance, as foundational treaties sought to balance sovereign autonomy with the demands of global cooperation. Documents such as the United Nations Charter (1945) and the Universal Declaration of Human Rights (1948) redefined sovereignty in ways that often marginalised localised governance frameworks, including Indigenous knowledge systems. However, this same period also laid the groundwork for recognising the role of diverse epistemologies in addressing global challenges, as seen in decolonisation efforts and the emergence of sustainable development as a global priority. Understanding this friction between international governance and localised autonomy is critical to justifying the liberation of Indigenous knowledge within global governance frameworks.

6.3.1. Development Narratives

The advent of post-World War II development was introduced through a blueprint that often conflicted with the needs of the countries it sought to develop (McGregor, 2007). Rather than adapting to local conditions and integrating Indigenous knowledge, the approach was centred on predetermined development narratives (Roe, 1991; Sharp, 2004). Roe describes this process as an enterprising development narrative, constructed to justify development interventions rather than learning from local realities. The power dynamics of this model are reflected in DuBois (1991), who examines the relationship between state apparatus and the masses, framing local populations as "human resources" requiring modification, adaptation, and change. Similarly, Marglin and Marglin (1990, p. 29) describe post-World War II development as a "massive and unprecedented project of social engineering in Third World countries**,"** arguing that its philosophical roots can be traced to Enlightenment ideals and colonial ethics. This characterisation is reinforced by Geels' Multi-Level Perspective (MLP) model, which illustrates how dominant socio-technical regimes sustain entrenched ideologies through institutional structures and governance mechanisms.

Mojito (2000, p. 47) further critiques development language, describing it as a "motivating device for soliciting subscribers." This characterisation aligns with Van Assche et al. (2014), who argue that the evolution from Third World development to post-development theories has been shaped more by external priorities than by local needs. Matthews (2004) similarly critiques this trajectory, drawing attention to how post-development discourse often overlooks Indigenous and context-specific alternatives. Tracing the founding institutions of modern development and their stated commitments is therefore essential for contextualising the focus of this paper.

6.3.2. Global Institutional Evolution

The Atlantic Charter, 1941 (National Archives, n.d.), signed by U.S. President Franklin D. Roosevelt and UK Prime Minister Winston Churchill, is often regarded as the precursor to the 1945 UN Charter. Ratified by twenty-six nations, the Charter's fundamental principles (United Nations, 1945) emphasised: i) The maintenance of international peace and security, ii) Cooperation in solving international economic, social, and cultural problems, and iii) The creation of a governance infrastructure that included the General Assembly, Security Council, Economic and Social Council, International Court of Justice, Secretariat, and Trusteeship Council (Article 7).

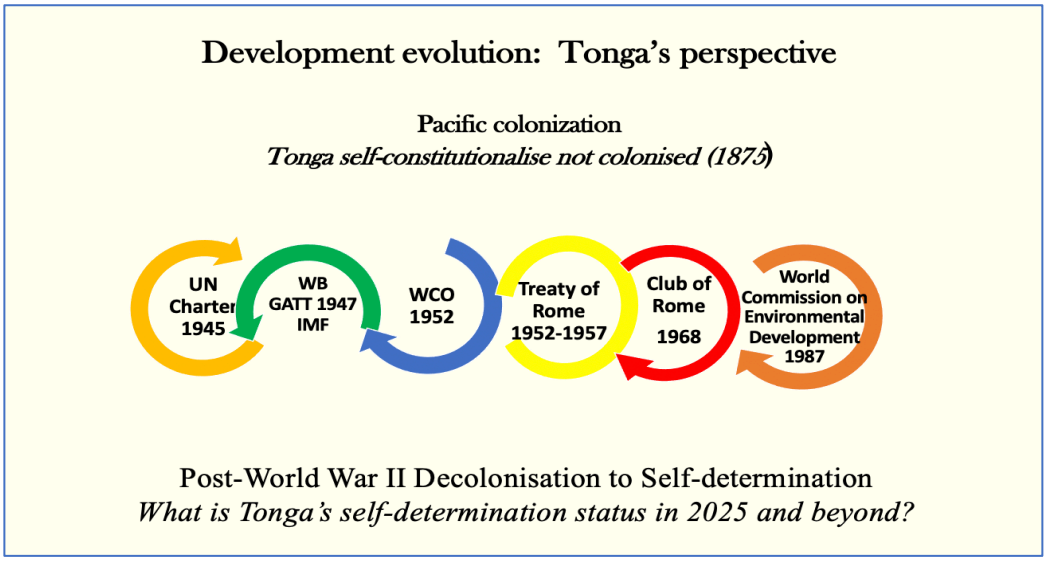
From the establishment of these UN organs, it is evident that an economic machinery was required to support the system. Two years later, the General Agreement on Tariffs and Trade (GATT, 1947) was signed by twenty-three nations (WTO, n.d.), aiming to phase out restrictive trade practices and promote equal treatment of products among member nations. The original signatories of GATT formed a Preparatory Committee, mandated by the Economic and Social Council of the UN, to draft a charter for a new International Trade Organisation (ITO) – an entity intended to function as a post-war economic agency for overseeing GATT. However, despite being signed by fifty-three out of fifty-six nations, the lack of ratification meant that the ITO never materialised (WTO, 1998). Instead, member countries negotiated trade relationships independently, leading to fragmented economic governance structures.

Five years later, the World Customs Organisation (WCO) was established as the administrative body for GATT. It developed instruments to achieve GATT's objectives, including a) The International Convention on the Harmonised Commodity Description and Coding System (World Customs Organisation, 2022), and b) Various trade conventions that facilitated

international commerce. Simultaneously, the Treaty of Rome, 1957 (European Parliament, n.d.) was signed, setting the foundation for European economic integration. If the UN Charter provided the governance infrastructure, and GATT facilitated economic interaction, then the Treaty of Rome formalised what would later become "One World Governance." This period marked the early stages of a borderless economy, ultimately shaping the global governance agenda outlined in "Our Common Future" (Brundtland, 1987).

From a historical perspective, this institutional evolution underscores the growing dominance of industrialised countries over Pacific nations. As depicted in Figure 6.3, this influence became particularly pronounced after World War II, though its roots extend further, through post-World War I agreements and even to the foundational principles of the Peace of Westphalia. These historical developments have significantly influenced the international relations and self-determination of nations such as Tonga, which will be explored in the next subsection. This historical trajectory reveals the structural challenges faced by Pacific SIDS in navigating global governance frameworks that were largely designed without consideration for their unique ecological and cultural realities. These conditions highlight the urgent need for innovative governance models that integrate Indigenous knowledge systems into sustainable development strategies, ensuring that Pacific SIDS can navigate globalisation without compromising their sovereignty and resilience.

Figure 6.2. Development evolution – a Tongan perspective



Source: Author's conception

6.4. Inequities in Existing Development Policies

6.4.1. PACER Plus Chapter 4

The World Trade Organisation contains the legal foundation for multilateral trade across the world. The principal objectives of the WTO, also of GATT, are raising standards of living, ensuring full employment, expanding production and trade, and allowing optimal use of the world's resources (GATT Secretariat, 1958, p. 1). Specific to Pacific SIDS, the Pacific Agreement on Closer Economic Relations Plus (PACER Plus) is an 806-page document that references various sections of the WTO manuscript. This manuscript, in turn, must be read alongside the most recent updates to the GATT 1994 provisions – both forming a complex system of rules that require arduous navigation. This intricate mesh of legal constructs is like a trawling net, promising freedom and better living conditions for the metaphorical fish. PACER Plus Chapter 4 is sufficient to illustrate the points made.

Article 2 outlines the Objectives, where Paragraph 1 (a) aims "to ensure predictability, consistency, and transparency in the application of customs regulations and laws of the Parties." These three binding principles provide a broad authoritative net at the discretion of customs personnel. This suggests that, at any point, the nation could be subject to the tightening of these mandates without legislative participation. Such discretion provides the opportunity for the quiet imposition of unforeseen constraints on national autonomy.

Sub-Paragraph I establishes the power of Paragraph (a) by aiming "to simplify and harmonise customs procedures." In practice, this stipulation seeks to negate the status quo, ensuring strict adherence to the rules outlined in the agreement. This creates a bureaucratic mechanism that operates without the audacity to respect individual actors, reciprocate with local stakeholders, and is built on a conflicting ontology compared to its subjects, such as Tonga and most Pacific SIDS. Sub-Paragraph (d) aims "to facilitate trade among the Parties and ensure the security of such trade". However, Tonga's experience has been incongruent with this objective. The produce of Tonga remains subject to the strict agricultural protectionist policies of its trading partners, limiting the intended benefits of facilitated trade.

Article 7 provides for Expedited Shipments. The phrase "to the extent possible" grants significant power to the Customs Authority in determining expedited clearance, while still maintaining appropriate control, as outlined in Sub-Paragraphs (a) to (c). These provisions, however, lean more towards facilitation rather than strict control of expedited shipments. Sub-Paragraph (a) promotes pre-arrival document processing; Sub-Paragraph (b) permits a single document covering all goods in the shipment; and Sub-Paragraph (c) aims to minimise the documentation required for the release of shipments.

Article 7 provides for Expedited Shipments, yet its phrasing, particularly "*to the extent possible*", confers considerable discretion upon Customs Authorities in determining eligibility for expedited clearance. While Sub-Paragraphs (a) to (c) focus on facilitative procedures such as pre-arrival processing, single-document submission, and minimal paperwork, the article remains notably silent on the qualifying conditions for expedited status.

This omission, when read alongside Article 8 (which allows shipment holds based on "risk management") and Article 11, Paragraph 2 (which reaffirms that discretion lies with Customs), reveals a framework that is not only vague but structurally permissive of selective access. In practice, this means expedited channels are more readily activated by actors with the institutional or financial capacity to navigate, or influence, customs processes.

In sum, the legal structure governing expedited goods, as detailed above, institutionalises extensive discretionary authority within customs administrations. Crucially, by failing to constrain or clearly define access criteria, the design privileges actors with political and economic leverage, thereby rendering the expedited regime inherently susceptible to elite influence and reinforcing broader patterns of asymmetrical trade relations.

Finally, under Article 12, the confidentiality of information related to Customs Procedures (Chapter 4) is protected. If the Customs Administration is required by law to disclose information under this Chapter, it "shall, wherever possible, give advance warning." This clause introduces a further layer of opacity, shielding decision-making processes from scrutiny.

This brief comparison allows for an assessment of Tonga's self-determination status in the context of international trade agreements. What has not been mentioned above is the role of

the International Monetary Fund (IMF), particularly its function in determining the volume of "currency" (Special Drawing Rights – SDRs) that each member nation may access for international trade. Pacific SIDS are among the countries with the lowest quotas, calculated based on the IMF's internal formula for SDR allocation.

From this position, in an environment of trade liberalisation, and considering the aforementioned provisions of PACER Plus Chapter 4, Tonga ventures forth with the winds of trade deficits and concessional loans behind its sails. The enticing narratives and terminology of Free Trade have cut its anchor, leaving it adrift, its right to self-determination drifting along with it.

The inequities in trade agreements such as PACER Plus mirror challenges observed in other externally imposed frameworks, including environmental and waste management policies, where externally designed solutions frequently conflict with the material realities and institutional capacities of Pacific SIDS.

6.4.2. Solid Waste Management Legal Framework

Waste management concerns are negative externalities of international trade. This problem is exacerbated by the small sizes of Pacific SIDS. Murray et al. (2015, p. 369) commented that the release of the Brundtland Report in 1987, commissioned by the UN, which established the need for caring for "Our Common Future," came at a time when global economies experienced unprecedented growth from the liberalisation of trade and capital movements across the world. As early as 1968, the Club of Rome foresaw the global issues with development based on unchecked economic and social growth. They invited scientists from various fields and nations to discuss solutions, resulting in the publication of the book "The Limits to Growth" in 1972.

The Brundtland Report was an effort to further these solutions, from which the field of post-development studies emerged. A landmark event in this progress was the 1992 Rio de Janeiro Summit, which highlighted waste management alongside the need to decouple economic growth from environmental degradation. Pacific SIDS featured prominently due to their remoteness and small size, rendering them vulnerable to climate change. This analysis is based on the nine areas assessed by the South Pacific Regional Environmental Programme (SPREP), which conducted a study in 2020 on nine Pacific SIDS, including Tonga (SPREP, 2020), assessing the legislative frameworks governing waste management (Section 2.4.2).

A close examination of the nine areas assessed by SPREP in their 2020 study on Pacific SIDS reveals that six focus on legislative suggestions for various aspects of waste management. Two address financing strategies, while the remaining area involves regulatory impositions and levies on specific items. However, this framework fails to address the underlying causes of the waste management crisis, such as the increasing importation of non-biodegradable materials, the impact of international trade, or the growing reliance on external goods. Furthermore, the policy does little to encourage innovation or promote sustainable waste management practices, leaving Pacific SIDS with few tools to deal with their mounting waste issues. Without incentives for local solutions or waste reduction strategies, the current legal framework remains reactive rather than proactive, exacerbating the long-term challenges of waste management in the region.

6.4.3. Energy transition

The energy transition in Tonga, aggressively pursued under the SDGs framework, reflects a policy direction heavily shaped by global sustainability targets rather than local economic and infrastructural realities. While Tonga has embraced this shift, the results have manifested in

high-cost infrastructure, governance instability, and increased electricity prices for the population (Vea-Simpson, 2024). This transition, while framed as a step towards sustainability and resilience, has placed a significant financial burden on the government, which has had to subsidise[37] energy costs to shield consumers from rising power bills. Additionally, the high turnover in governance and management within the energy sector signals structural inefficiencies that have made the transition difficult to sustain.

Despite being internally driven, the energy transition in Tonga mirrors the inequities found in trade and environmental policies, where external goals shape national policies without adequate alignment to local realities. While the SDGs emphasise renewable energy adoption, they do not account for the financial, governance, and operational challenges that Pacific SIDS face in implementing these transitions. The result is an energy sector that, rather than fostering self-reliance, increases economic dependency and financial vulnerability.

The analysis of both trade and waste management policies underscores the systemic inequities faced by Pacific SIDS, revealing a pressing need for development strategies that integrate local realities and Indigenous knowledge systems.

6.4.4. Conclusion: Inequities in Development Policies

The analysis of both the waste management framework and broader trade policies, such as PACER Plus, highlights a significant inequity in development strategies applied to Pacific SIDS. These policies often rely on a one-size-fits-all approach, which disproportionately

[37] Tongan Government announcement: https://finance.gov.to/node/601#:~:text=The%20Government%20of%20Tonga%20continues,Sione%20Faleafa%20or%20Ms.

burdens smaller nations with regulations and requirements that do not consider local realities. Whether through trade agreements that overlook the specific economic vulnerabilities of small island states or waste management policies that fail to address the root causes of environmental challenges, Pacific SIDS are constrained by international agreements and hooked by their associated financial incentives and setups funds, leaving them powerless to act in alignment with their knowledge and understanding of how to preserve their limited resources. Given these inequities, there is a pressing need for an alternative approach—one that integrates Indigenous knowledge systems and practices to foster resilience, sustainability, and genuine self-determination for Pacific SIDS.

6.5. Triple Helix literature review

Building on the systemic critiques of existing development policies, the Triple Helix model provides a theoretical lens for understanding how multi-institutional collaborations can drive innovation and development. It explores the specific dynamic interactions between universities, industries, and governments to address economic challenges and foster resilience[38].

The Triple Helix model originated from institutional collaborations in New England (US) as a response to the economic depression of the early twentieth century, which led to industrial decline in the region (Etzkowitz, 2013). The contextual details of this development are outlined in *Enterprises from Science: The Origins of Science-Based Regional Economic Development* (Etzkowitz, 1993). Building on this foundation, Etzkowitz (1998) and Etzkowitz and Leydesdorff (1998) developed the TH model to explain innovation dynamics through

[38] The distinction between economic and environmental resilience has traditionally been associated with industrial nations and SIDS, respectively.

interactions between universities, industries, and governments. They later identified three variations: Triple Helix I (state-controlled), Triple Helix II (separate institutional boundaries), and Triple Helix III (overlapping spheres with hybrid organisations) (Etzkowitz & Leydesdorff, 2000). The Triple Helix III model highlights the poly-contextual nature of innovation and provides a framework for understanding the foundational dynamics of innovation.

Cai and Amaral (2021) noted that while the Triple Helix is often regarded as a metaphor for university-industry-government relations, it also serves as a robust methodological tool for advancing innovation and entrepreneurship. Widely adopted by practitioners and policymakers for its practical utility in knowledge-based development, the model still has room for improvement—particularly in enhancing its explanatory power through meso-level theories that link macro- and micro-level analyses (ibid).

The spheres of the Triple Helix manifest their functional roles at pivotal moments in history. Its initial emergence occurred during the post-Depression era, when universities played a central role in addressing an industrially driven economic crisis. Fast forward to the 2007-2008 global financial crash, where central and local governments were called upon to take on a rescuing role (Etzkowitz & Ranga, 2009; Viale & Etzkowitz, 2010). The TH model illustrates how new regimes emerge through innovative collaboration, providing insights into knowledge-based development processes and fostering innovation (Ziolo et al., 2022). While not explicitly addressing Pacific SIDS, the model's adaptability suggests its potential relevance to the unique regional challenges they face.

Furthermore, multi-institutional systems such as the Triple Helix inhibit technological lock-ins by fostering ongoing variation and complexity (Leydesdorff, 2000), which can prevent settling on a single optimal solution. While this diversity promotes adaptability and flexibility, it also increases costs and inefficiencies, as more coordination is required, and stable, efficient trajectories may never fully materialise. Ironically, these systems often trade off efficiency and optimality for economic resilience and innovation in dynamic environments, potentially undermining their intended purpose. This dynamic may contribute to the growing debt crisis in industrial nations.

However, while the Triple Helix model offers valuable insights into fostering innovation through multi-institutional collaboration, its outcomes often reflect epistemologies and values rooted in its institutional origins. When these innovations are applied in Indigenous contexts, they may encounter conditional dissonance, where the foundational assumptions underpinning them do not align with local realities or frameworks. As Indigenous systems generate their own forms of knowledge and innovation, this highlights the need for alternative approaches that are intentionally designed to bridge these paradigms and honour the unique contributions of Indigenous epistemologies.

This highlights a critical gap in existing frameworks: the need for models that authentically integrate Indigenous knowledge systems to address the unique challenges and priorities of Pacific SIDS. Developing an Indigenous-driven approach can not only foster sustainable development that is locally grounded but also offer globally relevant insights into resilience, equity, and innovation.

6.6. Indigenous triple helix model: A catalyst for resilience

6.6.1. Introduction

If the Triple Helix model of innovation acts as a catalyst for economic transformation in industrialised nations, the I-TH model serves as a catalyst for environmental resilience and sustainability in SIDS. Unlike industrial nations, which depend on capital infrastructure and innovations as core elements of their economic identities, Pacific SIDS prioritise maintaining a harmonious relationship with their environment, particularly the land and sea, with an inherent emphasis on safeguarding resources for future generations. The I-TH model reflects this unique orientation, emphasising resilience rather than less relevant industrial growth. To fully appreciate this model, it is essential to acknowledge the significant differences in scale and context between Pacific SIDS and larger industrialised nations such as the USA. For instance, Tonga, a scattered archipelago with a population of approximately 100,000, comprises islands totalling around 750 square kilometres. Such conditions, marked by limited resources and fragile ecosystems, create societal needs and priorities that necessitate tailored policies rooted in environmental and cultural realities. These distinctive conditions shape the very structure of the ITH model, wherein environmental harmony permeates each of its spheres: God, People/Land, and Heritage, ensuring their alignment towards resilience and sustainability.

Helu (1999) posits that in ancient Tonga, power was valued primarily for its ability to deliver security, highlighting significant cultural divergences between Pacific SIDS and industrialised nations. During his explorations, Captain Cook observed Tonga possessing "some of the richest productions of nature" (Bott, 1982, p.15) and remarked upon the people's "love of singing and dancing and their very great skill and grace in both arts" (ibid., p. 53). These observations portray a society self-sufficient in sustenance and entertainment, emphasising relational harmony with the environment. In contrast, the resource-intensive approaches of industrialised

nations prioritise material wealth and external dependencies. Such historical perspectives offer valuable insights for re-examining the conventional sustainable development framework, often delineated through its economic, environmental, and social pillars. Moreover, the Pacific SIDS concept of wealth, or *koloa*, further challenges economistic paradigms by prioritising relational and cultural values over material accumulation.

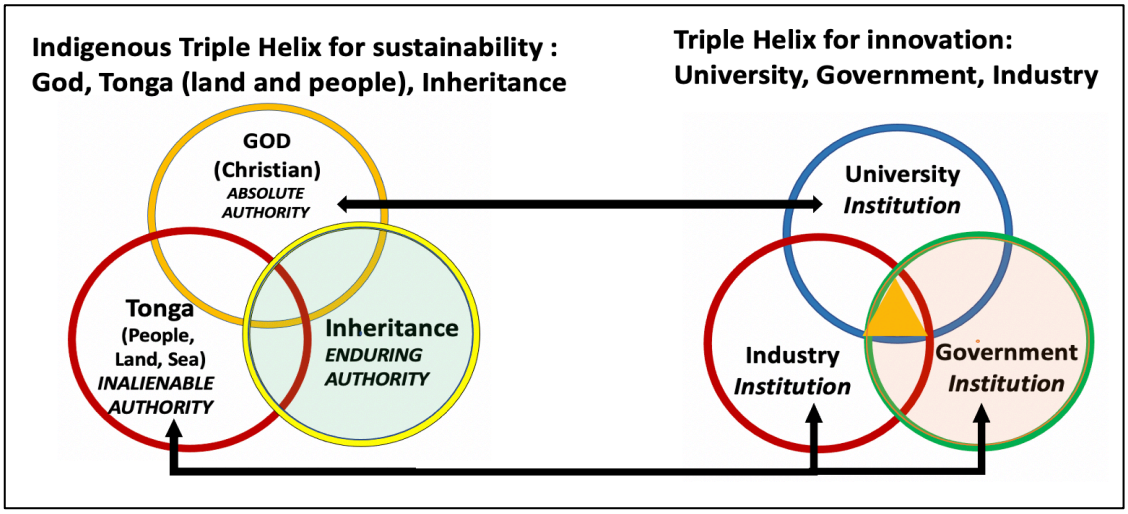
In Pacific cultures, wealth is measured not by material accumulation but by human capital (*nima mālohi*, or "strong arms") and social capital (*mamahi'ime'a*, or "selfless commitment"). As Hau'ofa (2008) argued, Pacific peoples are not 'too poor, too small'; this critique directly challenges economistic paradigms that equate wealth with material accumulation. Their so-called subsistence lifestyles, in harmony with their natural environment, exemplify sustainability. Adapted over generations, these practices can be conceptualised as an 'environmental circularity credit score'—a measure of how societies align their lifestyles with natural cycles and resource regeneration. In this regard, Pacific SIDS excel, demonstrating resilience in environmental adaptability. Recognising these conditions as strengths rather than deficiencies demands a rethinking of global sustainability frameworks, integrating lessons from Pacific SIDS in environmental and social harmony.

Building on the critique of the TH model's applicability to Pacific SIDS, the I-TH emerges as a framework uniquely aligned with these contexts. Far from being an invention, the I-TH is deeply rooted in Tonga's century-old motto, inscribed in the nation's Coat of Arms and established during a Great Council meeting in Pouono (Fusitu'a et al., 2023, p. 88). The motto, *God and Tonga are my Heritage* (used interchangeably with *inheritance*), originates from King George Tupou I's international relations policy and reflects a profound Tongan epistemology: the belief that God is the ultimate sovereign and guardian of the nation.

The I-TH brings this motto to life, transforming its spiritual and cultural essence into a practical framework for resilience and sustainability. By framing its three spheres, God, Land/People, and Heritage, as divine endowments rather than institutional entities, the I-TH emphasises a distinctly Tongan worldview where authority arises from cultural and spiritual interconnectedness. This philosophy stands in stark contrast to the TH model, which derives authority from institutional collaboration and rule-based bureaucratic governance, placing decision-making power in the hands of a select few. The TH model operates as a rigid, mechanical, and imposing structure that applies absolute principles with little room for contextual adaptability. In contrast, the I-TH model is organic and inclusive, sustained by the responsible nature of humanity, where resilience and sustainability are collective duties rather than institutional mandates.

Grounded in Tonga's historical and cultural foundations, the I-TH represents a groundbreaking framework that honours and reinterprets ancestral wisdom for contemporary sustainability challenges. Figure 6.3 illustrates this key difference, followed by an explication of their distinctions.

Figure 6.3. Juxtaposing the I-TH and the TH



Source: Author's I-TH conceptual model built on the work of Etzkowitz & Leydesdorff, 2000

6.6.2. Explicating the I-TH via the TH Lens

University institution versus God absolute authority

This sub-section begins by contrasting the first sphere of the TH - the University as a generator of institutional knowledge, with the God sphere in the I-TH - where knowledge derives from absolute spiritual authority. These foundational spheres highlight distinct ontologies that shape each model's approach to knowledge, governance, and sustainability. The TH is rooted in a scientific worldview, where universities serve as the primary generators of knowledge. In this model, knowledge is often centralised and exclusive, with access largely dependent on institutional and economic resources.

In contrast, the I-TH is grounded in a spiritual and cultural understanding of existence, where the ultimate authority of knowledge resides with a Creator God. In Tonga and much of the Pacific, the transition from reliance on ancient gods to Christianity was shaped by tests, experiences (Tafea, 1999, p. 29; Latukefu, 1969, pp. 98-99), and reasoning, blending spiritual beliefs with cultural identity. Through this ultimate authority of knowledge, Pacific

communities derive their resilience and sustainability, guided by a worldview that interweaves spiritual beliefs and cultural identity (Havea, 2018).

In the I-TH, God, as the Creator – including the source of all-encompassing knowledge, provides an understanding of the world that is revealed according to His will, allowing knowledge seekers and curious minds to engage with a holistic and inclusive epistemology. This inclusivity is reflected in the work of Indigenous researchers who, while advocating for Indigenous knowledge systems (IKS), Thaman (2006), also navigate Western academic frameworks, demonstrating that these traditions allow for a comparatively broader conception of knowledge. This stands in stark contrast to the TH, where knowledge is often constrained by institutional access and economic privilege. While the TH institutional focus is driven by technological and economic imperatives, the I-TH's spiritual and cultural foundation prioritises security, intergenerational sustainability, societal harmony, and well-being.

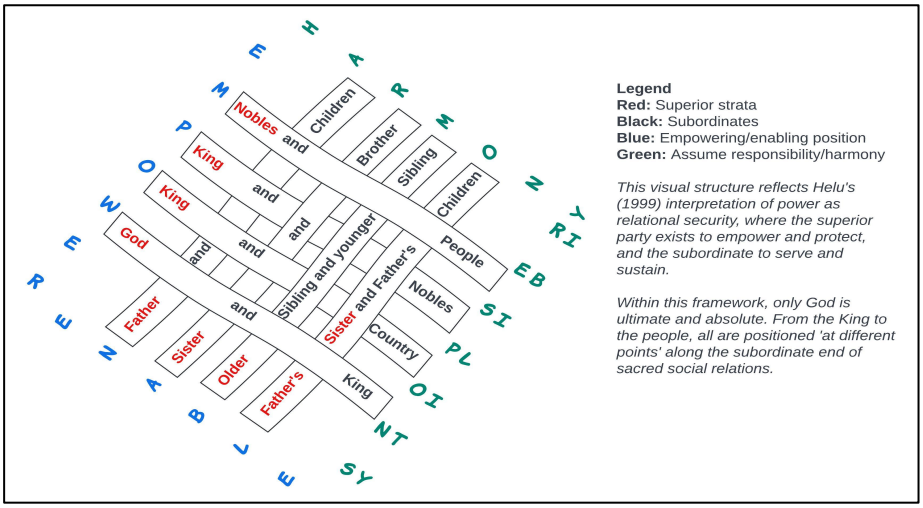
Furthermore, in the I-TH, knowledge is not confined to institutions but is cultivated through lived experience and evolves within the community over generations. The I-TH is embedded within IKS, which encompass 'specific systems of values, knowledge, understandings, and practices developed and accumulated over millennia' (Thaman, 2006). This accumulation of Indigenous knowledge aligns with the I-TH's emphasis on experiential and community-based learning as foundational to resilience and sustainability.

Government & Industry Institutions vs. People/Land Authority

The governance aspect of the I-TH is deeply embedded within the People/Land (Tonga) helix. Indigenous governance operates at the most foundational level, arising from birth rights and reflected in the Indigenous social pillar of sustainable development, a societal fabric woven

with inherent relational responsibilities that sustain harmony. Figure 6.4 is a reproduction of Figure 3.2 from Chapter 3 to illustrate this concept.

Figure 6.4. Fabric of Veitapui (Tapu relationships) in Tongan society



Source: Figure 3.2 from Chapter 3

These relational responsibilities are nurtured within a social structure that originates in God and is passed down to the most basic members of society. In the Tongan social construct, each individual holds multiple roles, rendering them significant at different points in time. This relational framework underpins hereditary rights to the throne, noble titles, and family land. Proper observance of this social order leaves little room for institutional bureaucracy or legalistic governance.

It is important at this point to recall Helu's (1999) statement in Chapter 3: that in tracing Tonga's ancient history, power 'has no other value but its capacity for delivering security.' Each superior entity in all the pairs of relationships in the *Veitapui* fabric, for example, King and God, assumes a secure power upon the other. This principle of relational security is a foundational Tongan and Pacific epistemology, ensuring that governance structures are upheld

through kinship-based trust rather than external institutional enforcement. This deep-seated principle of relational security extends beyond social and political hierarchies to the very foundation of governance: land tenure. In Tonga, land is not simply an economic resource but a sacred trust, reinforcing the social fabric and ensuring generational stability.

Tonga's Constitution explicitly decrees that land shall not be sold, a provision that affirms the collective ownership of Tonga by its people. This land system ensures economic sustainability while reinforcing governance structures rooted in Indigenous social fabric. The Constitution's equitable provision that land be exclusively registered to Tongans further solidifies the sacred connection between people, land, and Indigenous governance.

Enduring Inheritance and Heritage

The final sphere of the I-TH is *Heritage* (used interchangeably with Inheritance). This represents the intergenerational transmission of values, knowledge, and relational responsibilities tied to the land and the people. Heritage serves as the basis for sustainable well-being, focusing on the provision for future generations through today's practices. It is grounded in traditional industries, such as land cultivation and cultural craftsmanship, which emphasise relational stewardship, sustainability, and collective prosperity. In Tonga, these practices form the foundation of resilience, ensuring that future generations inherit both material resources and the cultural and spiritual wisdom necessary to steward them responsibly.

For men, Heritage involves working to the land, cultivating food, and practicing sustainable agriculture. For women, it centres on the creation of *koloa* (cultural wealth), such as tapa cloth and mats, which serve as practical goods and symbols of relational responsibility. These biodegradable resources are used for clothing, blankets, floor coverings and burial shrouds,

while also preparing daughters for marriage. The weaving of mats and making of tapa thus represent both cultural expression and long-term family investment (Helu, 1999 p. 301), aligning women's work with aspirations for sustainable wealth and social stability. Together, these gendered contributions illustrate how traditional industries sustain the well-being of future generations.

Tonga's motto, *"God and Tonga are my heritage,"* encapsulates the relational essence of the Heritage helix. It reflects the interconnectedness of land (*Tonga*), people, and their shared responsibilities under God's sovereignty. Unlike industries in the traditional TH, which prioritise economic growth and competition, Heritage emphasises cultural continuity, intergenerational equity, and environmental sustainability.

In the TH, industries represent privileged capital owners and those with economic means, while the broader population participates as consumers by trading their labour. These dynamics create visible yet opaque institutional walls, concentrating power and influence in ways that often neglect societal well-being. Industrial growth, while economically significant, frequently prioritises short-term gains over long-term sustainability, leaving communities vulnerable to environmental degradation and social inequities.

The Heritage helix in the I-TH reframes industries to align with cultural and environmental sustainability. A well-tended land cultivated by strong hands, and industrious women skilled in weaving and tapa making, are seen as indicators of a prosperous and resilient future. This principle even informed Tonga's modern education system, which was designed to prepare today's children for a better future, both individually and collectively, for the benefit of Tonga.

Ultimately, the Heritage helix embodies enduring authority, rooted in intergenerational wisdom and sustainable practices, where success is measured not by material accumulation but by resilience, cultural wealth, and relational harmony passed down through generations. This contrasts sharply with the industrial focus of the TH, which prioritises economic growth and competition. The Heritage helix ensures that land, cultural practices, and human relationships remain in balance, safeguarding both community well-being and the planet's future. It aligns with the Brundtland Report's call to leave the planet in a good condition for future generations while emphasising the active preservation of cultural and spiritual legacies.

6.7. Conclusion

The I-TH model offers a culturally grounded framework to address the shortcomings of current sustainable development policies in Pacific SIDS. Centred on the interconnected spheres of God, People/Land and Heritage, the I-TH aligns sustainability with spiritual authority, kinship-based stewardship, and intergenerational equity. Its transformative potential, however, depends on achieving genuine self-determination, something undermined by externally imposed policies such as waste management frameworks and the PACER Plus Agreement which prioritise Western economic interests over Pacific realities.

As an alternative to the traditional TH model, the I-TH re-centres decision-making on Pacific peoples themselves, guided by cultural values and relational responsibilities. This approach strengthens environmental stewardship while fostering holistic resilience – social, cultural, and economic. Key policy domains where the I-TH could be applied include education, governance and trade. Educational reforms that embed intergenerational knowledge, together with strategies that privilege local, sustainable production over dependency on imported goods, reflect the I-TH's principles and would contribute to meeting NDC and SDG targets.

A particularly urgent priority within the policy implications is trade reform. Current trade dependencies on unhealthy and unnatural food substitutes undermine both the health of Pacific communities and the sustainability of their economies. Reorienting trade policies to prioritise locally industrialised so-called subsistence farming (family self-sufficiency) and the production of traditional arts, such as tapa making and weaving, would strengthen economic self-reliance while preserving cultural identity. These industries, rooted in sustainable practices, align with the I-TH's principles of relational and environmental stewardship, reducing reliance on external material inflows and fostering a self-sufficient economy.

Although developed from the Tongan context, the I-TH is not intended as a uniform template for Pacific SIDS. Its specific expression—particularly the framing of God, People/Land and Heritage and its grounding in Tonga's motto, governance history, and cultural institutions—is Tonga-specific. The broader organising principle, however, may be adaptable: sustainable innovation can be structured around locally legitimate sources of authority, relationships between people and land, and intergenerational knowledge. Application elsewhere in the Pacific would therefore require adaptation to each society's own ontologies, institutions, and cultural priorities. Comparative testing beyond Tonga lies outside the scope of this thesis and is identified as a direction for future research.

Future research should examine how the three spheres of the I-TH interact to enhance sustainability and develop quantitative tools to measure its economic and environmental benefits. This would equip policymakers with the evidence base to integrate the I-TH into national development planning.

In sum, the I-TH model provides a viable and transformative pathway for Pacific SIDS to reconcile cultural heritage with modern sustainability imperatives. By embedding inclusivity, equity, and environmental harmony within a framework of self-determination, it offers a route to shared prosperity, resilience, and cultural continuity for generations to come.

CHAPTER 7

Conclusion

Introduction

This research investigates whether the Circular Economy (CE) can support Pacific Small Island Developing States (SIDS) in achieving their Sustainable Development Goal (SDG) and Nationally Determined Contribution (NDC) targets while maintaining self-determination. This question is both theoretical and applied, emerging directly from the author's professional experience drafting a Green Climate Fund proposal for the largest recycling company in the Cook Islands. To explore it, the research pursued three objectives: (1) a stocktake of CE strategies in three Pacific SIDS, analysed using a governance coevolutionary framework; (2) a measure of circularity in one Pacific SIDS using an economy-wide material flow analysis (EW-MFA); and (3) the development of a culturally grounded, context-specific theoretical model for sustainable transition. Together, these objectives blend empirical evidence with conceptual innovation to address a critical and timely challenge facing the region.

Accordingly, this thesis comprises three standalone research papers: two empirical studies and one theoretical paper. Two conference papers were developed in response to themes that emerged during the empirical research. These papers, shaped by the focus of their respective conferences, serve as supplementary explorations that enrich the theoretical development presented in the final paper. The remainder of this chapter is structured as follows. Section 7.2 summarises the findings from the three core research objectives, integrating insights from the two related conference papers. Section 7.3 outlines the research's key contributions to

knowledge, followed by Section 7.4, which reflects on the significance of the research context. Section 7.5 considers the study's limitations, while Section 7.6 identifies opportunities for future research. The chapter concludes with Section 7.7, which discusses the potential impact and policy implications of the findings.

7.1. Summary Findings

7.1.1. Objective 1: Institutional Coevolution and CE in Pacific SIDS

The quantitative stocktake of CE strategies in Samoa, Tonga, and the Cook Islands was significantly enriched by qualitative insights drawn from a governance coevolutionary analysis. Together, this mixed-methods approach provided new insights into the institutional and policy dimensions of CE in Pacific SIDS, an area previously underexplored in both regional and international literature.

While CE activities do exist in these Pacific SIDS, they do not emerge as part of any centralised or national sustainable development strategy. Andriamahefazafy and Failler (2021), in a similar study of African island states, argue that the absence of a coordinated national CE strategy can lead to suboptimal outcomes. However, the findings from this study suggest that decentralised, culturally embedded projects, such as Samoa's community-based biogas initiatives, can achieve meaningful success in advancing energy transitions, even without a national CE framework.

Beneath the recorded CE activities, the decision-making processes and institutional structures reveal deeper layers through consideration of the *actor-institutional, material-economic, and discursive dimensions.* This study uncovers a cultural dissonance when attempting to apply

industrially derived sustainability frameworks within the Indigenous and cultural settings of Pacific SIDS. The degrees of adaptation vary by nation. For instance, Samoa's biogas initiatives are implemented through traditional institutional strengths, leveraging the *fa'asamoa* (Samoan way of life), which is deeply rooted in community chiefdom (Matai) and kinship networks. This culturally aligned approach maximises benefits within *matai*-led communities and illustrates how Indigenous institutional logics can effectively support sustainable goals.

In contrast, Tonga's national projects, including its energy transition initiatives, reflect a monarchical cultural structure that prioritises centralised administration. This approach has led to costly projects that face continuous learning curves. Similar outcomes were observed in nationally administered CE-related efforts, such as the Ocean Management regime, where cultural values shape strategy and impact. Samoa and the Cook Islands place kinship and community leadership at the heart of decision-making, which informs their national policies. However, Tonga mirrors its hierarchical, monarchical culture, with decision-making centralised among elected representatives who occupy the top of the "actor institutional" hierarchy, distancing the decision-making process from community involvement. This is evident in Tonga's Ocean Management[39] and Energy Transition strategies, which prioritise bureaucratic implementation but risk overlooking long-term community impacts.

A critical insight from the analysis is the continued reliance of Pacific SIDS on imported goods, which constrains their CE potential and contributes to what is later termed in Research Paper 2 as a "circularity gap." Current approaches to waste management are minimal, and the accumulation of capital stock, such as buildings, infrastructure, and durable goods, receives

[39] The Tonga Ocean Management regime appears to grant community control, but it is largely bureaucratic, gradually removing community access rights via Fish Habitat Reserves.

limited policy attention. In the absence of strong national CE frameworks, waste management systems across the three SIDS are largely directed by the Secretariat of the Pacific Regional Environment Programme (SPREP), a legal and self-financing regional body. While this external support is technically viable, it also raises concerns about self-determination and the extent to which Pacific SIDS can design waste strategies that are culturally aligned and logically governed.

This study provides policymakers with foundational insights into how CE strategies operate in practice, offering a comparative understanding across three Pacific SIDS that vary in size, economic focus, and cultural orientation. Despite these differences, the SIDS share key cultural features, particularly kinship networks and chiefly systems that influence material economic decisions and shape how sustainability is governed. These findings underscore the importance of culturally grounded institutions and narratives, referred to in the study as actor institutions and discursive dimensions, in enabling context-appropriate and resilient transitions.

7.1.2. Objective 2: Quantifying Circularity – An EW-MFA of Tonga

This paper employed a quantitative method to measure the circularity rate of a Pacific SIDS—specifically, Tonga. The quantitative approach is grounded in the *System of Environmental-Economic Accounting (SEEA)*, with a dedicated focus on Economy-wide Material Flow Accounts (EW-MFA). Analytical methodology was derived from the EW-MFA framework, producing objective data to support policy decisions. The methodology and results are readily replicable for other Pacific SIDS, providing a foundation for comparative studies. The findings for 2022 are as follows:

1. *Circularity Rate:* Tonga was found to have a zero percent circularity rate. While no domestic secondary-material flow was quantified in the available 2022 EW-MFA data, approximately 2,000 metric tons of recyclable waste were set aside for export.

2. *Domestic material consumption and energy use:* In 2022, approximately 529,000 metric tons of material were allocated to domestic material consumption (DMC). Of this, approximately 482,000 metric tons, or 91 percent of DMC, were attributed to energy use (eUse). The substantial energy-use flow, particularly the large biomass component, highlights the significance of energy and organic material flows within Tonga's socioeconomic metabolism.

These results reveal an absence of targeted policy addressing the substantial levels of biomass waste generated through national material flows. Additionally, the dominance of biomass in energy use has significant implications for public health, waste management, and long-term economic resilience. The high volume of imported processed foods, along with the associated waste packaging, further undermines Tonga's trade balance, contributing to financial outflows and a widening trade deficit.

1. *CE Policy Implications:* These findings reinforce the earlier observation from Study 1 that uncoordinated CE strategies often produce suboptimal outcomes. Notably, while Tonga's national energy strategy includes ambitions to develop a biomass production industry, it fails to integrate existing biomass waste streams. This policy misalignment is echoed in Tonga's 2021/2022 Waste Report and is further explored in the second conference paper.

2. *Capital Stock Contribution:* Material use (mUse) accounted for approximately 45,000 metric tons, or 9 percent of DMC. Of this, approximately 43,000 metric tons, or 96 percent of mUse, were allocated to net additions to stock (NAS), representing materials retained in the economy for longer-term use. This distinction provides a clearer indication of the relationship between Tonga's overall material consumption and the comparatively smaller share directed to longer-lived material use.

3. *Data Gaps:* As the first EW-MFA study conducted for a Pacific SIDS, this research exposes critical data gaps, particularly concerning waste from capital stock and related indicators. While the findings provide a foundational baseline, they also highlight a promising area for future empirical research to inform policy and deepen understanding of material circularity in the region.

4. *Global Data Centralisation Issues:* The study also identifies limitations associated with globally centralised data systems, especially concerning Tonga's Domestic Extraction (DE) figures. Based on contextual understanding and insights from the first paper, the DE figure may be overstated, potentially inflating local production data and distorting the balance between imports, DE, and overall Direct Material Input (DMI).

Together, these findings underscore the structural and policy challenges Pacific SIDS face in operationalising the CE. Tonga's zero circularity rate, reliance on biomass and external data governance reflect a broader vulnerability to externally imposed frameworks and inefficiencies in local resource systems. Without deliberate policy shifts to integrate existing waste streams, enhance capital stock utility and localise data infrastructure, efforts to meet SDG and NDC targets will remain constrained. Moreover, the findings highlight the need for CE strategies

that are not only technically robust but also aligned with Pacific values of self-determination and local stewardship.

7.1.3. Objective 3: Indigenous Framework for Sustainable Transition

This third paper develops the Indigenous Triple Helix (I-TH) model as a culturally grounded framework for sustainable development decision-making in Tonga, with broader relevance for Pacific Small Island Developing States (SIDS). Inspired by Etzkowitz and Leydesdorff's (1998) Triple Helix (TH) model, which emphasises collaboration among government, industry, and universities, the I-TH model reinterprets this framework through Tongan cultural constructs.

In both models, the helices represent the central entities that drive development, but their underpinnings differ fundamentally. In the Western TH model, the helices are institutions—government, industry, and universities—which derive development through innovation, resulting from collaborations that generate technological and economic advancement. In contrast, the I-TH model is rooted in natural, inalienable, and enduring authorities that are not man-made institutions but fundamental realities of existence. The I-TH model is structured around three authoritative helices, drawn from Tonga's belief system, which guided the national motto, 'God and Tonga are my Heritage': i) God, the ultimate authority, who provides spiritual and moral guidance; ii) People and land (Tonga), the empowered authority, which governs social and economic activity through relational responsibilities; and iii) Heritage (Tofi'a), the enduring authority, ensuring sustainability for future generations.

Rather than functioning as institutions that collaborate through structured agreements, these three authoritative helices operate as interconnected, relational forces that sustain governance, social structures, and economic activity. Unlike the Western model, which relies on formal institutional cooperation, the I-TH model is deeply embedded in Tonga's social and cultural systems, where governance, industry, and sustainability are woven together through kinship ties, land stewardship, and spiritual values.

Within this model, the land and the people form a distinct helix, maintaining their inseparable connection. The land and sea serve as a metaphorical placenta, nurturing and sustaining Tongan society. The I-TH model ensures that governance and economic activities are not separate sectors, but relational functions tied to kinship structures and land-based responsibilities. Historically, this structure influenced land allocation, transitioning from customary land tenure to a registered land ownership system.

At the core of this model is Tofi'a, a term that signifies inheritance and heritage while also being future-oriented. When the people and land helix functions effectively within governance, it fosters productive industries and resource sustainability. This, in turn, secures the final helix, Heritage (Tofi'a), for future generations, embedding sustainability into governance, social structures, and economic activities.

By leveraging its existing cultural relationships, the I-TH model provides an embedded alternative to externally imposed development frameworks. It offers a pathway to sustainability that aligns with Tongan values, bypassing the high costs, learning curves, and industrial dependencies of Western innovation models. Together, these elements establish the I-TH

model as a culturally grounded approach to sustainable development, preserving Tongan heritage while addressing contemporary and future challenges.

In sum, the I-TH model offers a culturally grounded pathway to sustainable development that centres self-determination, relational governance and intergenerational responsibility. By reframing development through Tongan ontologies and values, the model challenges dominant institutional paradigms and illustrates how Pacific SIDS can pursue SDG and NDC targets without sacrificing cultural integrity or autonomy.

7.1.4. Synthesising Chapters 2 to 6

The research presented in Chapters 2 to 6 builds a comprehensive understanding of how sustainable transitions in Pacific SIDS can be effectively realised through a contextually adapted CE framework. Each chapter contributes critical insights, progressing from empirical analysis of CE adoption challenges to the development of an Indigenous governance model for sustainability.

Chapters 2 and 4 – Empirical Studies on Circular Economy

The empirical foundation for this research was established in Chapters 2 and 4, which examined the systemic challenges and opportunities for CE adoption in Pacific SIDS.

Chapter 2 presented the first systematic stocktake of CE strategies across Samoa, Tonga, and the Cook Islands, providing an overview of existing CE-related activities, their distribution, and their alignment with national policies. While the stocktake identified CE initiatives, it revealed that these activities are largely fragmented, lacking integration within broader sustainability frameworks. The findings confirmed that CE transitions in Pacific SIDS are not

centrally driven but emerge from independent projects, community-led innovations, and external funding streams.

To understand the structural and institutional factors shaping these CE patterns, the study incorporated governance coevolutionary analysis, which examined discursive, institutional, and economic lock-ins. This deeper investigation exposed the cultural dissonance between industrial sustainability models and Pacific decision-making systems, demonstrating that CE adoption is significantly shaped by governance traditions. For example, while Samoa's CE strategies are embedded in its community-led Matai system (fa'asamoa), Tonga's highly centralised governance structures introduce institutional barriers that can impede bottom-up sustainability efforts.

Chapter 4 complemented this governance analysis with the first Economy-Wide Material Flow Analysis (EW-MFA) conducted in a Pacific SIDS context. This quantitative assessment provided valuable insights into resource flows, circularity gaps, and waste management inefficiencies, reinforcing the need for policy adjustments that align CE with Pacific realities. Together, the stocktake, governance analysis, and EW-MFA findings highlight both the constraints and opportunities for CE adoption in the region, underscoring the need for culturally adapted frameworks such as the I-TH model.

Chapter 3 – Matters Arising 1

The first conference paper, Matters Arising 1, provided an initial cultural lens through which sustainability in Tonga was examined. This study introduced three fundamental Tongan pillars of sustainability, offering a localised interpretation of economic, social, and environmental dimensions: *i) Veitapui* (Personal authority) embodies the social dimension, illustrating how

Tonga's stratified social structure governs relationships, leadership, and responsibility within communities. *ii) Moʻunga ki he Loto* (Mountain to the heart) represents the economic dimension, reframing development as an enabler of cultural well-being, rather than a pursuit of economic expansion. *iii) Fonua 'a e Kakai* (The land is the people) articulates the environmental dimension, reinforcing the inseparable connection between land and community well-being.

These cultural principles directly challenge industrialised conceptions of sustainable development, highlighting the incompatibility of Western sustainability frameworks with Tongan values. As such, Matters Arising 1 reinforces the argument that sustainable transitions in Pacific SIDS must be built on Indigenous principles rather than externally imposed models.

Chapter 5 – Matters Arising 2

Expanding on these cultural insights, Matters Arising 2 explored the practical application of sustainable transition frameworks within global development targets such as the Sustainable Development Goals (SDGs) and Nationally Determined Contributions (NDCs). This chapter demonstrated that Indigenous governance structures – when properly acknowledged and incorporated – can align with international sustainability frameworks without compromising cultural integrity. The research confirmed that Pacific-led transitions must integrate both traditional knowledge systems and data-driven policy tools to ensure a balanced approach that respects self-determination while addressing climate and development commitments.

Chapter 6 – The Indigenous Triple Helix Model

Building upon the empirical insights and cultural foundations developed in the preceding chapters, Chapter 6 introduced the I-TH model as a structured framework for self-determined

sustainable development. Unlike the traditional TH model, which centres on institutional collaboration between government, industry, and universities, the I-TH model reconfigures decision-making around authoritative relationships that reflect Tonga's cultural foundations. The model is built upon three interwoven authorities, as reflected in Tonga's belief system and national motto, 'God and Tonga are my Heritage': *a) God (ultimate authority)* – the source of spiritual and moral guidance, framing decision-making within an ethical and values-based system. *B) People and land (empowered authority)* – representing the inseparable connection between governance, industry, and environmental responsibility. *C) Heritage*/Tofi'a (enduring authority) – securing intergenerational sustainability, ensuring that present-day decisions align with long-term cultural and ecological well-being.

This alternative governance model offers a culturally embedded approach to CE and sustainability that enables Pacific SIDS to transition without being forced into institutional industrial frameworks.

Addressing the Central Research Question

The thesis set out to answer the overarching question: *Can Circular Economy advance Pacific SIDS' SDG and NDC targets while maintaining self-determination?* Drawing on a regional stocktake of CE activities, a first-of-its-kind circularity analysis (EW-MFA), and the development of a culturally embedded governance model, this research affirms that the answer is yes: EW-MFA provides an evidence base for policy intervention, while the I-TH ensures alignment with cultural values and social legitimacy. Together, these elements confirm that sustainable development in Pacific SIDS must integrate rigorous empirical tools with Indigenous frameworks for governance. Only through this dual approach can CE transition respect both the development goals and the self-determination of Pacific peoples.

7.2. Research Contribution

This study makes an original contribution to ST research by integrating empirical analysis, governance coevolutionary perspectives, and Indigenous epistemology into a structured framework for CE adaptation in SIDS. It challenges prevailing assumptions in global sustainability research, demonstrating that sustainable transitions must align with local governance realities and cultural traditions rather than be imposed through externally driven models.

A key contribution of this study lies in its empirical findings, which provide the first systematic assessment of CE strategies in Pacific SIDS. The stocktake of CE activities in Samoa, Tonga, and the Cook Islands highlights how CE adoption is fragmented, externally influenced, and shaped by governance traditions rather than national policy frameworks. These findings offer critical insights for policymakers, reinforcing the need for CE approaches that are contextually embedded rather than imposed through universalised industrial models.

This research also marks a significant methodological advancement through the first EW-MFA in a Pacific SIDS context, measuring Tonga's material flows, resource dependencies, and circularity rate. The results reveal a zero-circularity rate, indicating that waste is either exported or left unmanaged, with no domestic recycling processes in place. The analysis exposes fundamental gaps in national material flow data and highlights the need for evidence-based policymaking to address systemic inefficiencies.

Beyond its empirical contributions, this study extends sustainability research by incorporating governance coevolutionary analysis into CE transitions. It demonstrates that governance traditions, rather than simply policy instruments, shape the pathways and effectiveness of CE adoption. Samoa's Matai system fosters community-driven sustainability, whereas Tonga's centralised governance creates institutional barriers to local engagement. These findings offer new insights into the intersection of governance structures and sustainability outcomes, an area that has received limited attention in CE research.

The study's theoretical contribution is the development of the I-TH model, which provides a culturally embedded framework for decision-making in sustainability transitions. Unlike the traditional TH model, which is based on institutional collaborations between government, industry, and academia, the I-TH model is structured around three authoritative relationships:

I. God (ultimate authority) – guiding decision-making through ethical and moral governance.
II. People and land (empowered authority) – reinforcing the inseparable link between governance, industry, and environmental responsibility.
III. Heritage/Tofi'a (enduring authority) – ensuring intergenerational sustainability by securing resources and knowledge for future generations.

By embedding sustainability transitions within cultural governance systems, the I-TH model challenges the assumption that development must be structured around industrial institutions. Instead, it proposes a self-determined sustainability framework that enables Pacific SIDS to pursue development within their own governance realities.

This study also makes an important theoretical and policy contribution by reframing self-determination as a fundamental pillar of sustainability. The research demonstrates that Pacific SIDS often operate within externally driven sustainability models, leading to governance dependencies that do not foster long-term resilience. The findings reinforce that self-determination is not merely a political concern but an essential condition for effective sustainability transitions. Without it, sustainability efforts risk reinforcing economic dependencies rather than fostering true resilience and autonomy.

In addition to its theoretical contributions, this research carries practical implications for policymakers and future research. It provides a structured framework for measuring circularity, allowing policymakers to track resource efficiency, waste management, and sustainability transitions over time. The study also highlights the importance of aligning policy mechanisms with local governance realities and cultural traditions, demonstrating that top-down sustainability interventions can create structural misalignments when they do not reflect Indigenous governance norms.

Finally, the research carries broader significance for both policy and future scholarship. It provides a replicable framework for measuring circularity, identifies clear misalignments between imported models and local realities, and offers an actionable approach for embedding cultural principles into CE strategies. Together, these contributions advance a transformative view of sustainable development in Pacific SIDS: one that calls for redefining CE through Pacific realities rather than forcing Pacific systems into global frameworks.

7.3. Significance of the Context

This study emerges from a unique research trajectory, one that diverges from traditional academic pathways and offers a perspective on sustainability governance. The practical origins of the research, rooted in the researcher's role as a Pacific-based appointee with New Zealand's Volunteer Service Abroad (VSA), provided direct exposure to sustainability challenges and governance practices in the region. This background shaped the research direction, offering insights that might not have been accessible through conventional academic structures.

Unlike sustainable development studies for Pacific SIDS that are externally funded by international agencies, this research examines CE from the standpoint of an independent Pacific SIDS insider. The grey literature in this field is often sponsored to fulfil specific policy objectives, utilising externally developed research templates that are applied with limited contextual adaptation, thereby shaping the way research is conducted and reported.

In contrast, this study is free from external funding constraints, allowing the research to present data as they are, without external influence. This strengthens the objectivity and reliability of the findings, ensuring that sustainability solutions are framed from within Pacific governance realities rather than imposed from external perspectives.

In the global sustainability landscape, where policy solutions and funding mechanisms are often driven by major economic centres such as Brussels and New York, this study holds a unique and timely position. As CE frameworks gain traction in industrialised nations, there is a pressing need to contextualise these frameworks for Pacific SIDS. This research, being the first of its kind to focus exclusively on Pacific CE governance, provides insights that are directly relevant to regional policy decisions, reinforcing the need for Pacific-led transitions that align with local governance traditions.

An essential and uniquely situated dimension of this research is the access to family archives, which enabled an in-depth exploration of Tongan epistemology, governance traditions, and land-based sustainability practices. The inclusion of ‘Eua land allocation systems, the genealogy of landholders, the lasting implications of the *Veitapui* violation, provided an alternative lens for understanding governance and sustainability. These sources offer a deeply rooted epistemological foundation that extends beyond policy discourse, highlighting how traditional knowledge systems have long sustained resource management and intergenerational stewardship in Tonga.

The ‘Eua land allocation system, for instance, exemplifies an Indigenous governance framework that balances communal needs with ecological preservation, reinforcing the notion that sustainability is an inherent feature of Pacific governance rather than an externally introduced concept. Similarly, the genealogy of landholders reveals a lineage-based model of environmental stewardship, linking land use, governance, and sustainability outcomes across generations. The *Veitapui* violation, which remains deeply embedded in community memory, serves as a case study in the consequences of disrupted governance protocols, illustrating how Pacific societies have historically maintained resilient and adaptive governance systems.

By incorporating these unique cultural perspectives, this research makes a significant contribution to the field of sustainability transitions. It illuminates alternative pathways for Pacific-led development, reinforcing that sustainability is not merely a global mandate but a practice inherently embedded within Indigenous knowledge systems. It also demonstrates the value of decolonising sustainability research, ensuring that Pacific SIDS are not positioned as

passive adopters of external policy frameworks but as active architects of their own sustainable futures.

This approach reframes sustainability governance in the Pacific, providing a model where CE and sustainable development are grounded in land-based social structures and cultural authority systems. In doing so, it offers a critical intervention in global sustainability discourse, ensuring that Indigenous governance systems are recognised as legitimate foundations for environmental stewardship and self-determined development.

7.4. Reflexive Statement on the Research Journey

At the conclusion of this doctoral research, the interplay between the researcher's positionality and the outcomes of the study came into sharper focus. The researcher's cultural embeddedness as a Tongan offered unique insights into the social and cultural dimensions of the work, yet it also meant that certain culturally grounded facts, when presented without external substantiation, could appear as assumptions to an unfamiliar audience. A pivotal moment of reflexive learning emerged from feedback provided by a reviewer of an article authored during this research. The critique noted unsubstantiated references to Tongan cultural practices within the material flow analysis, such as descriptions of lavish feasts marking life milestones. This underscored the importance of situating cultural knowledge within an academically robust framework, ensuring that even widely recognised practices are appropriately referenced. The realisation subsequently strengthened the research's scholarly approach.

Another important insight arose from the ethical complexities of conducting culturally embedded, data-rich research. In the Tongan context, data integrity often relies on relational

ethics, where trust and implicit cultural agreements shape the quality of participant contributions. Navigating these dynamics required balancing cultural norms with formal ethical frameworks to ensure the study upheld both cultural relevance and academic validity.

The interdisciplinary nature of the study also presented challenges. Each discipline brought distinct priorities, methodologies, and standards, requiring significant cognitive and methodological flexibility. Reflexively managing these differences was critical to maintaining rigour and coherence while addressing the demands of multiple fields. Striking a balance between these disciplines, while staying true to the study's objectives, represented an ongoing negotiation throughout the research process.

A further tension emerged in integrating qualitative and quantitative approaches. The richness of qualitative content sometimes seemed at odds with the streamlined clarity required in presenting quantitative data. Although complementary, the two approaches occasionally interfered with one another during the cognitive process. Managing this tension reflexively, within the constraints of space and methodological coherence, demanded iterative adjustments to ensure that qualitative narratives enhanced rather than overshadowed quantitative findings.

Taken together, these experiences shaped not only the trajectory of the research but also the researcher's scholarly development. They underscore that Pacific-based, culturally embedded research requires an ongoing reflexive stance, one that recognises the interplay between researcher, context, and method. Ultimately, this thesis demonstrates that reflexivity is not an add-on but an integral part of producing knowledge that is both academically rigorous and culturally grounded.

7.5. Limitations

This study's contributions must be considered alongside its inherent limitations, many of which stem from its non-traditional research trajectory and interdisciplinary approach. While these challenges introduced certain constraints, they also shaped the study's unique contributions, enabling novel perspectives that challenge conventional academic structures.

7.5.1. Topic and Process

The research originated outside traditional academic pathways, initially posing challenges in positioning its epistemological foundations within established disciplinary frameworks. The complexity of sustainability transitions – which intersect governance, economics, and cultural studies – further complicated this process. However, rather than constituting a limitation, this approach allowed the study to transcend conventional academic compartmentalisation, leading to insights that may not have emerged within more rigid disciplinary structures.

A further constraint relates to the publication-driven nature of the research. While the peer review process ensured rigour and high research quality, the format-imposed word limits, editorial constraints, and thematic focus areas limited the study's ability to present a broader, monographic narrative. However, the benefits of structured peer review outweigh these constraints, as it refined the study's methodological and analytical depth.

In addition, the study's primary focus on Tonga, with supporting analysis from Samoa and the Cook Islands, limits the generalisability of findings across the wider Pacific. While the cultural themes discussed are widely resonant, each Pacific SIDS has distinct governance structures and colonial legacies that may require localised adaptations of the frameworks proposed.

7.5.2. Data

The study's policy-driven research required the use of non-traditional data collection and analysis methods, making direct comparisons with conventional sustainability studies difficult. Despite this, the chosen methodologies were validated through peer review, ensuring their academic credibility.

A key limitation was the reliance on secondary data in the Economy-Wide Material Flow Analysis (EW-MFA). While these datasets were sourced from national and international environmental-economic accounting databases, they remain in development, with some inconsistencies persisting. Future improvements in Pacific material flow data will enable greater accuracy in resource tracking, strengthening subsequent research in this field.

Moreover, limited disaggregated data, particularly on capital stock and domestic extraction, restricted the ability to conduct a full circularity analysis. As a result, the findings should be understood as a directional baseline rather than a definitive representation of national material flows.

7.5.3. Cultural Dissonance

One of the study's most revealing insights was the role of social capital in Pacific SIDS, particularly in achieving national sustainability objectives through community-led initiatives. First-hand observations confirmed that local cooperation, rather than formal institutions, drove the success of key sustainability projects. These insights were captured in a separate paper, "Could Intangible Tongan Koloa, as a Cultural Value System, Serve as a Comprehensive Form of Social Capital?"

The researcher's involvement in these community initiatives initially occurred for non-research purposes. During participation, their potential academic value became apparent. Following discussion with the lead supervisor, this academic interest was disclosed to the relevant groups and permission was obtained to draw upon material arising from two of the projects. The third project involved publicly observable activities, including the researcher's family participation on the same basis as other participating families.

A Massey University Low Risk Notification had been completed for the initial scoping stage, but this did not constitute full Human Ethics Committee approval for the subsequent ethnographic use of material arising from the community projects. Accordingly, detailed ethnographic material requiring full Human Ethics Committee approval was excluded from the thesis. Community permissions, anonymisation, and other safeguards are described in Section 5a.4.2. Full Human Ethics Committee approval would be sought before any future publication of material excluded on this basis.

7.5.4. Inherent Biases

As this research advocates Indigenous governance approaches for sustainability transitions, it is necessary to acknowledge potential biases. The study prioritises contextual sustainability solutions, centring governance traditions within cultural epistemologies. To provide methodological balance, a purely positivist study, the EW-MFA, was incorporated, ensuring that quantitative empirical findings complement governance and Indigenous knowledge insights. This mixed-methods approach ensures that conclusions remain grounded in both measurable data and culturally embedded policy considerations.

Nevertheless, the researcher's insider status and close involvement in both community initiatives and cultural institutions may introduce confirmation bias. Although the study takes

a reflexive approach, the interpretation of events, frameworks, and governance systems is inevitably shaped by the researcher's positionality. This underscores the need for future studies to include external validation or triangulation with independent perspectives.

Finally, while the I-TH model offers a culturally grounded framework for sustainable development, it remains conceptual. Its effectiveness and scalability across other Pacific contexts have yet to be empirically tested. Future research could explore the application of the I-TH model in policy planning and community governance.

7.6. Recommendations for further research

This study would be complemented by an EW-MFA for Samoa, given its documented use of biomass waste for community-based energy, as identified in the CE stocktake covering Samoa, Tonga, and the Cook Islands. A dedicated EW-MFA study for Samoa would complement the present research, providing a more complete understanding of biomass energy use in the Pacific context and allowing for more robust comparative analysis across case studies.

Extending EW-MFA methodologies to additional Pacific SIDS would offer new empirical insights into regional resource use, waste generation, and circularity potential. A multi-country comparative analysis could generate higher-level knowledge on Pacific material flow trends and better inform regional import and development policies. Particularly relevant would be the role of imported processed foods and their impact on public health, environmental degradation, and economy leakage. Future research could examine how CE policy can support local food production and reduce reliance on unsustainable imports.

The I-TH Model also warrants further investigation. While its components are based on ethnographic insights, they have not yet undergone quantitative validation. Thematic literature reviews on each element of the helix could provide preliminary data to support or refine the model, while conventional surveys and questionnaires would yield empirical data to further test and confirm the I-TH framework.

Finally, this thesis opens multiple research pathways, not only for the Pacific but for other Small Island Developing States globally. Future work may explore the adaptation of CE and Indigenous governance models to different sociocultural settings, further enriching global sustainability theory and practice.

7.7. Conclusion: Impact and Policy Directions

This research carries significant implications for the sustainable development pathways of Pacific SIDS. Drawing from a stocktake of CE activities, it uncovered core institutional conditions shaping circularity in the region. In response, the I-TH model was developed, grounded in Indigenous epistemology and land-based governance, to provide strategic direction for future CE policy development. This culturally legitimate and contextually grounded approach enables a more relevant alignment with the SDGs and supports the advancement of NDCs.

The Sankey diagram from the EW-MFA conducted in Tonga delivers immediate policy insights across multiple sectors. For instance, the annual material use at the national level provides an indication of capital investment volumes, carrying implications for economic and infrastructure planning. Similar assessments across other Pacific SIDS could offer comparable

insights, helping policymakers prioritise investments in sustainable infrastructure and resource management.

In the case of Tonga, the large volume of biomass waste identified in the EW-MFA reveals an underutilised resource stream that could be integrated into a national biomass energy strategy. Instead of establishing new agricultural and livestock-based biomass systems, existing waste biomass could serve as a foundational input, increasing the country's circularity rate while reducing environmental burdens and import dependencies.

Additionally, the significant reliance on imported food across Pacific SIDS suggests potential for policy reform by the Ministry of Health and the Ministry of Food and Agriculture to promote healthier, locally grown food. Reducing imports of less nutritious foods would not only benefit public health but also retain economic resources within the local economy, positively affecting the balance of payments and alleviating associated financial pressures.

In sum, this research underscores the potential of a CE framework that is anchored in Indigenous governance traditions and land-based social systems. Such an approach offers credible and culturally appropriate pathways to achieving the SDGs and fulfilling NDC commitments, while also addressing health, economic, and environmental priorities. The findings demonstrate that sustainability in Pacific SIDS must be built upon self-determined development models that reflect local realities.

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Appendices

Tonga research permission



PRIME MINISTER'S OFFICE
NUKU'ALOFA, TONGA

Ref: ORG 1/8 v.22

30th January, 2023

Mrs. Litia Vea Simpson
[redacted]
NEW ZEALAND

Dear Mrs Litia Vea Simpson,

RE: Tonga Government Research Permit

I have the honour to inform you that your application to carry out research in Tonga on your doctorate thesis entitled *"An analysis of the material flows of a Pacific SIDS: How circular are they?* has been approved.

Your proposal has complied with all the relevant requirements under the Government Research Policy as stipulated under His Majesty's Cabinet Decision No.410 of 12 May 2011.

This permits allows for your fieldwork to be conducted for a period of six weeks from 01 June to 14 July, 2023 and upon request may be extended at our discretion. Your research schedule may be changed with the approval of the Tonga Ministry of Education and Training.

We note that your research includes participants from Government, please note that you will be required to contact them and comply with any further requirements that they may have.

Thank you for pledging that you will abide by the following Government of Tonga Research Policy. At the end of your research you are requested to kindly deliver to this office 2 completed copies of which one will be sent to the Ministry of Education and Training.

I wish you all the best in your research endeavours and looking forward to receiving your thesis.

Sincerely,

Mr. Paula P Ma'u
Chief Secretary & Secretary for Cabinet

Cc: *CEO, Ministry of Education & Training*
CEO, Ministry of Agriculture, Food & Forests
A/CEO, MEIDECC
Government Statistician

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Multiple authors' statement

Chapter 3

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GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	Litia Vea-Simpson
Name and title of main supervisor:	Associate Dean Maori, Professor Mathew Roskruge
In which chapter is the manuscript/published work?	Chapter 3

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Litia Vea-Simpson: Led the conceptual development of the Three Pillars framework, undertook the literature review and cultural analysis, and prepared the manuscript.

Professor Matthew Roskruge: Contributed scholarly and supervisory guidance to the development of the paper, reviewed the conceptual framing and interpretation, provided critical feedback on the manuscript, and approved the final version.

Please select one of the following three options:

- ○ **The manuscript/published work is published or in press**
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  AlterNative: An International Journal of Indigenous Peoples
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Student name:	Litia Vea-Simpson
Name and title of main supervisor:	Associate Dean Maori, Professor Mathew Roskruge
In which chapter is the manuscript/published work?	Chapter 4

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Litia Vea-Simpson collected and processed the data and is the primary author.

Professor Matthew Roskruge directed, supervised and reviewed the manuscript.

Please select one of the following three options:

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  Asia Pacific Sustainable Development Journal (APSDJ), for the Economic and Social Commission for Asia and Pacific (ESCAP). October (2025) Vol 32, Issue 2.

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Student name:	Litia Vea-Simpson
Name and title of main supervisor:	Associate Dean Maori, Professor Mathew Roskruge
In which chapter is the manuscript/published work?	Chapter 5

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Litia Vea-Simpson developed the conceptual framework and regional model, undertook the supporting analysis, and led the preparation of the manuscript.

Professor Matthew Roskruge contributed regional-science expertise, provided scholarly guidance, and critically reviewed and refined the manuscript.

Please select one of the following three options:

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- ◉ The manuscript is currently under review for publication
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  Australian Journal of Regional Studies
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Chapter 6

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Student name:	Litia Vea-Simpson
Name and title of main supervisor:	Associate Dean Maori, Professor Mathew Roskruge
In which chapter is the manuscript/published work?	Chapter 6

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Litia Vea-Simpson conceptualised the study, developed the Indigenous Triple Helix (I-TH) framework, undertook the theoretical analysis, and prepared the manuscript.

Professor Matthew Roskruge provided conceptual guidance, supervision, and critical review of the manuscript.

Please select one of the following three options:

- (●) **The manuscript/published work is published or in press**

  Please provide the full reference of the research output:

  Vea-Simpson, L., & Roskruge, M. (2026, in press). Indigenous Triple Helix (I-TH): A culturally grounded framework for sustainability in Pacific SIDS. In Charging the Blue Economy: Lessons from and Recommendations for Pacific Island Countries. Springer Nature.

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