Small Island Digital States: Exploring the Relationship Between Digitization, Statehood, and Climate Change-Induced Sea-Level Rise in Tuvalu

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Honours Thesis in Sustainability, Science & Society

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April 30, 2025

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Abstract

Climate change, specifically sea-level rise (SLR), poses a significant threat to small island developing states' (SIDS) physical landmass, territorial integrity, and sovereignty, raising critical issues related to land rights, human rights, and international law. Tuvalu, a SIDS in the Pacific, faces disproportionate threats to SLR, making its coastal populations and natural-resource-based economies acutely vulnerable to climate change-induced displacement. In response, Tuvalu has pioneered the creation of their "digital twin"—Digital Tuvalu. Through an extensive literature review and semi-structured interviews, this paper explores the implications of digital state preservation on Tuvalu's statehood and sovereignty in national and international contexts while considering human rights, land rights, digital governance, and geopolitics. The five main conclusions emerging from a thematic analysis of semi-structured interviews are: 1) adaptive leadership, national agency, continued international support, and transparent community consultation are essential for digital state preservation, 2) Digital Tuvalu as a double-edged sword, 3) Digital Tuvalu as reshaping conventional climate imaginaries, 4) the intangibility of culture and heritage, and 5) implications for ethical justice and intellectual property. Hence, digital preservation of Tuvalu's statehood, sovereignty, and cultural heritage is a complex process that must consider diverse stakeholders, the rights of displaced populations, geopolitical influences, and traditional ecological knowledge. I argue that Digital Tuvalu fundamentally challenges traditional international notions of statehood and sovereignty, suggesting that these concepts require revision. Therefore, I examine how Digital Tuvalu provides valuable insights into the future of statehood and sovereignty, encouraging other SIDS to leverage and critique digital technologies as critical tools for navigating the uncharted waters of climate change.

Keywords: small island developing states, Tuvalu, digital sovereignty, digital twin, sea-level rise, statehood, Pacific

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Statehood has historically been rooted in the physical presence of a territory, a population, a government, and the capacity to enter relations with other states [1]. However, in recent decades, climate change has challenged these conventional interpretations of statehood and sovereignty, especially in the context of small island developing states (SIDS) whose land area is only a part of their territory [2]. Tuvalu, a SIDS located in the Pacific Ocean, comprises nine coral atolls and reef islands. Situated approximately midway between Hawaii and Australia, Tuvalu is one of the world's smallest and least populous countries, covering a total land area of about 26 square kilometres (10 square miles) and is home to approximately 11,000 residents [4]. The nation is characterized by its low elevation, with the highest point only about 4.5 metres (15 feet) above sea level [5].

This geographic vulnerability has led to disproportionate threats from sea-level rise (SLR), making Tuvalu's coastal populations and natural resource-based economies particularly susceptible to climate change-induced displacement. Scientists estimate that by 2050, 50 percent of Funafuti, Tuvalu's capital and residence to over half of the population, may be inundated by tidal waters [3]. Moreover, these environmental challenges are exacerbated by Tuvalu's classification as a least developed country (LDC), given its limited potential for economic advancement, lack of exploitable resources, and its small size, along with its vulnerability to external economic and environmental shocks [6].

Despite such challenges, Tuvalu is pursuing what was thought to be the unimaginable: "an island state existing purely in the metaverse" [7]. This future was made possible when the Tuvaluan government explained their new program titled *Te Ataeao Nei* (known in English as

Future Now) [6]. Simon Kofe, the former Minister for Justice, Communication and Foreign Affairs, spearheaded this campaign as it debuted at COP27, the UN climate conference (Conference of the Parties of the UN Framework Convention on Climate Change) held in November 2022 in Sharm el-Sheikh, Egypt [7]. This viral video made waves through its virtual reality application in which Kofe appears to be standing on the Tuvaluan beach. However, by the end of his speech, viewers face a thought-provoking reality: the Minister is standing on a computer-generated island [7]. This video and subsequent project briefs for a digital nation represent Tuvalu's opposition to victimhood in the face of climate change [7].

The Future Now program is comprised of three initiatives. Initiative 1 aims to promote ethical and moral principles reflected in Tuvaluan cultural values such as *olaga fakafenua* (community living), *kaitasi* (shared responsibility), and *fale-pili* (being a good neighbour) via bilateral, regional, and international forums and diplomatic relations [8]. Initiative 2 comprises efforts to secure international recognition of Tuvalu's statehood as permanent by embedding in the 2020 Tuvalu Foreign Policy *Te Sikulagi*—a provision that Tuvalu will only form new bilateral relations with nations that recognize Tuvalu's statehood and existing maritime boundaries as permanent [8]. Initiative 3 will focus on efforts to digitize all government services and establish digital archives of Tuvalu's history, effectively creating a Digital Tuvalu [8]. This initiative pursues alternative avenues to intellectual property law while encouraging national efforts and legal protections to preserve and digitize Tuvalu's historical and cultural documents [8]. Despite all three initiatives being deeply interconnected, for my research on Tuvalu's e-governance and statehood, I will be mainly focusing on Initiatives 2 and 3.

The innovative introduction of this Program is only one component of the nation's response to the existential threat posed by SLR. Tuvalu has advocated for global climate action

and international support with the United Nations Framework Convention on Climate Change (UNFCCC), calling for more robust measures to mitigate climate change and adapt to its impacts [10]. Adaptation strategies being explored by Tuvalu include constructing sea walls, elevating infrastructure, and promoting sustainable land management practices. The unique challenges experienced by Tuvalu stress their "capacity for adaptation and innovation; their proven capability to overcome many adversities; their role as one of the world's front-line zones for addressing the challenges of sustainable development" [3]. Consequently, this determination to save homes, businesses, livelihoods, and national identity has manifested itself in the Digital Tuvalu project, which aims to preserve the country's culture in a digital format. At the heart of this technological endeavour is the mapping of complex relations between people, ancestors, and natural landscapes in a virtual space that enhances the Tuvaluan concept of *fenua* (belonging and identity) [7].

However, this adventure is connected to colonial and Eurocentric perceptions of the Pacific Islands as "small, isolated, remote, and resource-poor" [11]. Resisting such colonial narratives, the *Te Ataeao Nei* (Future Now) program aims to instill agency when faced with a potential future of statelessness. While SLR poses significant challenges to Tuvalu's sovereignty and national identity, this digital program transforms traditional legal interpretations of statehood as the authority of a state to govern itself without external interference. Consequently, technology becomes deeply intertwined with territorial integrity. For Tuvalu, as for other low-lying states, pursuits of legitimate statehood, when faced with SLR, raise critical questions about the displacement of the Tuvaluan people, a national identity and cultural heritage.

In this paper, I aim to highlight how Tuvalu's predicament is a powerful example of the challenges that SIDS face in the context of climate change and the threat it poses to their

sovereignty. Rising sea levels not only endanger the physical existence of these nations but also challenge fundamental concepts of sovereignty and statehood as traditionally understood in international law. As the global community continues to grapple with the realities of climate change, Tuvalu's experience will play a crucial role in shaping future legal, ethical, and political discussions about how to support and protect nations that face existential threats from environmental changes. The outcomes of these discussions could redefine the very nature of statehood and sovereignty in the 21st century.

Here, I contribute to the growing literature on issues of statehood and sovereignty in the face of climate change. I present the case study of Tuvalu, a low-lying SIDS that is fighting rising sea levels encroaching on their territory, to argue that sovereignty must extend beyond legal definitions and consider cultural relations, geo-political influences, and political interpretations. I draw upon traditional notions of statehood as "being rooted in the physical presence of a territory, a population, a government, and the capacity to enter relations with other states" to examine how Tuvalu's introduction of a digital nation pushes sovereignty and national identity to uncharted territory [12]. In exploring the role of digital technologies as tools for maintaining sovereignty in the face of climate change, I have generated the following research question: How can digitization initiatives, such as the development of digital governance and virtual statehood, mitigate the challenges posed by sea-level rise to the sovereignty, identity, and statehood of small developing island states?

Using Digital Tuvalu as a case study, I inquire about the political and legal implications of virtual statehood and highlight the inherent need for preserving and promoting national identity, culture, and community cohesion when faced with climate-induced displacement. By considering the implications of digital advancements on sovereignty and statehood, my research

aims to uncover the need for a closer look at why these have become issues in the first place. Such an analysis motivates the investigation of how digital pathways, such as Digital Tuvalu, are now becoming potential realities for countries. Therefore, this research could lead to valuable insights into how SIDS leverage innovation to sustain their sovereignty in the face of climate change, while also contributing to global discussions on the evolving nature of statehood in the digital age.

It is important to note that lived experiences, responses, and mitigation strategies for coping with climate change-related events vary between SIDS. As such, this case study's focus on Tuvalu limits the generalizability of the findings for other island states experiencing climatic and environmental risks. Despite being a context-specific case study, this does not prevent applicable insights from being derived about the understanding of sovereignty via physical geography and legal jargon. Hence, Tuvalu's venture into the digital age highlights the interconnected roles of culture, power relations, human rights, environmental injustice, and historical relations when adapting to climate change.

The rest of this paper is as follows: **Section 2** provides a literature review of traditional interpretations of statehood and sovereignty, their relation to Tuvalu, the threats to Tuvalu's physical statehood, and Digital Tuvalu as an innovative response. **Section 3** presents an overview of the methodology employed, which is two-fold: a case study and semi-structured interviews with relevant stakeholders. The case study of Tuvalu includes a qualitative data analysis of project briefs, policies, and legislation regarding recent amendments in Tuvalu's response to SLR. The interviews include meetings with Tuvalu's government ministers, university professors, climate change NGOs, and UN representatives to discuss the viability of Tuvalu's digital statehood and future recommendations for preserving the nation's identity. The

discussion in **Section 4** outlines the key findings, focusing on the themes developed from my conversations in Section 3. Themes include the legal implications of digital statehood, sovereignty in a digital age, the rights of displaced populations, and international relations. **Section 5** provides further considerations for investigating the relationship between SLR and statehood, drawing on ethical implications, traditional ecological knowledge, and varied experiences amongst SIDS. Finally, the conclusions of **Section 6** extend this case study to other SIDS, highlighting the role of digital technologies as innovative responses to SLR by reorienting traditional legal, political, geographical, and social interpretations of sovereignty.

Literature Review

Scope and Purpose of the Review

This academic overview of statehood, SLR, and Digital Tuvalu will outline how scholarly, peer-reviewed, and grey literature accounts for climate change in SIDS. Mapping these interconnections is essential for understanding how Euro-western notions of environmental vulnerability, resilience, and global advocacy frame Tuvalu as the "poster child of climate change" [32]. This literature review leverages current academia to generate a landscape on how digital advancements have transformed sovereignty and statehood in the face of climate change. Since my analysis investigates how digital pathways, such as Digital Tuvalu, emerge as potential realities for countries, a literature review is critical for situating Tuvalu within current political, legal, and geopolitical arenas.

Statehood and Sovereignty

Definition of Statehood. Extensive legal literature and international law have explored the criteria for statehood, which provides a sufficient basis for understanding traditional

interpretations of nationhood in global forums [1, 12, 13, 14, 15, 16, 52]. Most notably, the Montevideo Convention on the Rights and Duties of States was adopted by the Seventh International Conference of American States on December 26, 1933, in Montevideo, Uruguay. This pivotal treaty outlined the criteria for statehood and the rights and responsibilities of states in international law. Specifically, it stipulated that all states were equal sovereign units with i) a permanent population, ii) defined territorial boundaries, iii) a government, and iv) the ability to enter into agreements with other states [12]. Considered a foundational document in international law, this Convention emphasized principles of state sovereignty and equality, stating that all states have the right to exist independently [12]. Further, it detailed the rights and duties of states, including each nation's right to defend itself. The Convention mandated respect for the rights of other states and non-interference in their internal affairs [12]. Finally, the Convention emphasized that political recognition by other states is essential for full cooperation in international forums [12]. The Montevideo Convention reaffirmed customary international law while formalizing existing legal norms applicable to all entities in international law. It has remained influential in contemporary discussions of statehood and diplomatic relations.

The criticality of this legal framework is enhanced by political and legal discussions of statehood. A breadth of literature has explored the relationship between geopolitics and statehood, critiquing existing debates and dominant discourses on state recognition in the face of capitalism, positivism, and transitioning international relations [19, 20, 21, 22]. By exposing the politics of knowledge and positionality, contemporary literature has leveraged historical legal agreements, such as the Montevideo Convention, to investigate how statehood encompasses diplomatic discourses, performances and entangled agencies [19]. In re-visioning state recognition through geopolitics, spatial management, and power dynamics, contemporary

literature critiques traditional statehood [22]. Instead, scholars note that recognizing a state as a new entity becomes a political move since each country decides for itself whether to extend such acknowledgment [23]. Statehood and polity are interconnected. Legal normativity and political architecture coalesce to design institutions and express cultural norms, centring the state in larger international relations [23].

Challenges to Statehood. However, as recent literature suggests, the Montevideo Convention faces "limited applicability in today's international relations" [17]. The current global landscape—complicated by globalization, climate change, digitization, and migration—is not the same as it was during the signing of the 1933 Convention. In the 21st century, statehood is subject to profound challenges [18]. Specifically, climate change will affect the physical territory of states through desertification, increased soil salinity, coastal erosion, SLR, and flooding of low-lying regions [24]. Extensive literature has explored how climate change renders certain lands, such as island nations, incapable of sustaining human populations, resulting in forced migration [24, 52]. Several scientific estimates suggest that by the end of the 21st century, SIDS, such as Tuvalu, Kiribati, the Marshall Islands, and the Maldives, may be rendered uninhabitable due to SLR [24, 52]. This potential loss of physical territory questions the continued statehood of these entities. Hence, climate change challenges traditional criteria of statehood, ultimately reshaping the legal construction of states. Several scholars have questioned whether these historical legal interpretations are adequately positioned to deal with climate change's threat to statehood and sovereignty [7, 24, 25, 26, 27, 28, 52].

While typical references to the birth and death of a state originate from the Montevideo Convention, climate change in SIDS and Tuvalu, especially, are redefining legal interpretations of a defined territory, permanent population, government, and the capacity to enter relations with

other states [29]. Consequently, some scholars argue that if a country's territory becomes uninhabitable and its residents are forced to leave, then statehood is lost [29]. However, others posit that this loss of physical territory cannot automatically translate to the disappearance of sovereignty [29]. As a result, environmental changes threaten territorial integrity, adding complexity and nuance to legal scholarship.

However, ethnographers argue that these legalistic approaches "tend to overlook politico-economic dimensions of sovereignty," especially in SIDS, which vary across geographical contexts [29]. Instead, statehood must expand beyond legal definitions and adopt a broader approach that includes geopolitical, cultural, environmental, and economic considerations. As recent scholarship argues, for island nations like Tuvalu, sovereignty becomes a political strategy for establishing international relations [7]. Within the global arena of climate change mitigation and adaptation, sovereignty can be leveraged for skillful diplomacy. Understanding legal and political interpretations of statehood emphasizes how the concept influences environmental governance and climate action. Instead of equating sovereignty with judicial borders and land mass, I leverage contemporary scholarship's discussions of complex geopolitical dynamics to introduce internal and external notions of sovereignty [29].

Tuvalu's Position in Global Politics About Climate Change. To understand the implications of Tuvalu's sovereignty, one must draw upon literature in geopolitics, history, and ethnography. One cannot conduct a literature review of these nine atoll islands without addressing how "history and structure intertwine" [29]. As highlighted by many scholars, colonialism, extraction, and environmental racism have translated into Tuvalu's current uncertainty [29]. Tuvalu is central to the global warming debate despite being the smallest independent Polynesian nation-state [32]. Such a misalignment is rooted in colonialism, both

past and present, that has influenced international notions of island vulnerability and resilience in the Global South [32]. Academic literature outlines how Pacific societies with similar environmental profiles have shared past experiences of colonial rule; however, they each hold unique geopolitical positions across international relations and climate diplomacy [32]. Recent literature has contested Western interpretations of Pacific Island nations, questioning common extinction narratives and geopolitical humiliation associated with these populations [32, 36, 37, 38, 39, 40, 41]. Instead, they investigate how these accounts are influenced by deeply intertwined histories of colonialism and racial capitalism [32, 36, 37, 38, 39, 40, 41]. Historical analyses show how extinction narratives of these "doomed" islands exercise a "colonial logic of disposability" that has manifested into contemporary discussions on climate change [11]. International forums, which posit these nations as vulnerable and helpless, naturalize and reframe previous forms of violence and exploitation in the Pacific [11]. By understanding the colonial classifications of land and people in the Pacific Islands, historians posit that the "slow violence of climate change" emerges [11]. I will evoke these understandings of climate change as a colonial continuity by leveraging local agencies and proactive diplomacy to exhibit how Pacific Islands, such as Tuvalu, are taking adaptation measures into their own hands. By incorporating these historical considerations into my literature review, I hope to emphasize how Tuvalu's geopolitical significance lies not only in its strategic location but also in its role as a crucial player in the dialogue surrounding climate change and environmental sustainability.

Sea-Level Rise and Its Implications

Climate Change in Tuvalu: A Threat to Tuvalu's Physical Statehood. Global sea levels are rising at an average of 3.3 millimetres per year [5]. However, SLR rates recorded by the Funafuti tide gauge show higher rates of 3.9 millimetres per year over the past 40 years [5].

Given Tuvalu's average elevation of 1 metre above sea level and total land area of 26 square kilometres, the nation is situated at the frontlines of SLR [5]. Even small increases in sea level could drastically impact the food and water security, housing, and infrastructure of Tuvalu's coastal populations [5]. As projected by the Australian Bureau of Meteorology and CSIRO, under a minimum emissions scenario, a 13–29-centimetre increase in sea levels is expected before 2050, and a 29-67-centimetre increase in sea levels before 2090 [5]. These issues are compounded by saltwater intrusion, changes in sea temperature pH, as well as the severity and frequency of tropical cyclones [5]. Over the years, water has flooded roads, buildings, infrastructures, and livelihoods, limiting mobility in Funafuti [33]. Consequently, it is estimated that fifty percent of Funafuti will be uninhabitable by 2050 [33]. On a national scale, ninety-five percent of Tuvalu's land is predicted to be below sea level by 2100 [53]. Extreme impacts from inundation and flooding have resulted in several of Tuvalu's islands being uninhabitable and the shrinkage of exclusive economic zones (EEZs) [5].

These environmental damages translate to local concerns about livelihoods [51]. For instance, residents of Funafala expressed concerns over these coastal changes, citing that "if the tide is high, all the crops and plants are destroyed—our lives depend on that local food" [37]. With fewer opportunities for fishing and subsistence agriculture, residents will require immediate adaptation efforts [37]. However, adaptation will not be cheap, as estimates range from US$50 billion per year [10]. In response to these worst-case scenarios, Tuvalu's *Te Kaniva* (Tuvalu Climate Change Policy) highlights relocation, adaptation, and land reclamation as ways to "foster a resilient nation that is habitable to current and future generations" [37]. With such policies, Tuvalu has positioned climate change adaptation as a key priority for its islands [5]. Such government reports are supported by international UNFCCC discussions advocating that

"developed countries shall assist the developing countries in meeting costs of adaptation to climate change" [11]. This agreement manifested on November 9, 2023, when Australia and Tuvalu signed a cooperation agreement called the Falepili Union, which grants 280 Tuvaluans permanent residency in Australia per year [11]. Integrating climate cooperation, mobility, and security, Australia commits to contributing AU$11 million to the Tuvalu Coastal Adaptation Project [11]. However, scholars highlight how many Tuvaluans express dissatisfaction with the relocation aspect of this agreement due to a lack of transparency and consultation [33].

This policy's contentious nature is situated within larger international discussions on the impacts of climate change. In these forums, Tuvalu has echoed other small atoll archipelago states, such as Kiribati, the Marshall Islands, and the Maldives, to increase awareness of SLR's damaging impacts [42]. For instance, Honourable John Briceño, Prime Minister of Belize's speech at the UNGA High-Level Meeting on threats of Sea-Level Rise on September 25, 2024, stated:

> It takes far more than a rising tide to jurisdictionally wipe away entire countries. International Law clearly affirms that the ocean cannot erase a people or nation: sovereignty is defined by the will of the people, not by the whims of climate change. Once a state is established, it will endure and thrive, no matter the challenges it faces [55].

During this event, the 39 presidents and prime ministers of the Alliance of Small Island States (AOSIS) issued a Declaration on Sea-Level Rise and Statehood, articulating that countries will retain their statehood, sovereignty, and UN membership regardless of SLR [55]. This declaration aligns with international law and historical state practices to reinforce the principle of

continuity of states [55]. It will aid the UN International Law Commission's report on SLR concerning International Law, which is expected to be presented later in 2025 [55].

Most recently, Tuvalu has amended its constitution to reflect a new definition of statehood [49]. As the first of its kind, this amendment outlines that Tuvalu's historical, cultural, and legal frameworks shall remain in the future, uninfluenced by climate change or other threats to Tuvalu's physical territory [49]. Tuvalu has formalized this agreement with other countries. The Bahamas, Cook Islands, Gabon, Republic of Kosovo, Marshall Islands, Niue, Palau, Saint Kitts and Nevis, Saint Lucia, Taiwan, Vanuatu, and Venezuela have signed joint communiques acknowledging Tuvalu's permanent sovereignty [50]. Eighteen Pacific Islands Forum (PIF) nations have pronounced the continuance of their statehood despite climate change [49]. A total of 35 countries recognize Tuvalu's digital sovereignty [49].

Challenges to Statehood in the Context of Tuvalu. As previously stated, Tuvalu's positionality as "a powerful symbol of global struggle" and an "obligatory passage point for climate diplomacy" has redefined traditional legal interpretations of sovereignty [29]. However, a breadth of literature highlights how Tuvalu faces the possibility of losing significant portions of its landmass due to SLR [5]. With a mean elevation of 2 metres, Tuvalu has experienced a SLR of 15 centimetres over the past three decades, one-and-a-half times the global average [30]. By 2050, NASA scientists project that daily tides will submerge half of the main atoll of Funafuti, home to 60% of Tuvalu's residents [30]. Further, coastal erosion and land loss have practical implications on maritime boundaries and EEZs. With the highest land-to-sea ratio in the world, Tuvalu's EEZ stretches 750,000 square kilometres [31]. However, coastal erosion can contribute to disputes over territorial waters and resources, further complicating the notion of a defined territory for Tuvalu. This threat of losing one's physical land questions whether a state, such as

Tuvalu, can continue to exist if it no longer has a defined, habitable territory. Legal scholarship has attempted to answer such a question by posing three alternatives for the continued existence of SIDS post-territory loss [31]. A nation could either create new territory artificially, acquire new territory, or exist as a deterritorialized nation *ex-situ* [31]. *Ex-situ* statehood is defined as "a status that allows for the continued existence of a sovereign state, afforded all the rights and benefits of sovereignty amongst the family of nation-states, in perpetuity" [31]. However, each pathway is heavily debated.

Further, scholars have introduced displacement as an issue when defining Tuvalu's statehood since climate-change-induced movement threatens the permanence of populations—a key criterion in the Montevideo Convention. More than 70% of households in Kiribati and Tuvalu felt that migration would be a likely response if SLR worsened [34]. If residents are forced to migrate to other countries, it challenges notions of a "permanent" population within the state's territory. Tuvaluans may become climate refugees, dispersing across different countries [51]. However, it is important to consider that numerous scholars have highlighted that for Tuvalu, most migratory drivers stem from better work opportunities, access to health services, and benefits for their children [33]. This complexity asserts that environmental challenges, such as SLR, are not the only factors for migration out of Tuvalu [33].

Additionally, governance becomes an issue when populations are dispersed, and physical territory is lost. If Tuvalu were to exist as a deterritorialized nation *ex-situ*, Tuvaluans would have a unified political entity that remains constant even as its citizens establish residence in other states [31]. This approach maintains Tuvalu's governance by conserving the existing state and upholding the resources and well-being of its citizens despite geographical barriers [31]. For Tuvalu, *ex-situ* statehood would involve a continued state authority that manages any remaining

resources in the original territory while operating as a "political and cultural nucleus" to extraterritorially preserve the nation's culture and security [54 in 31]. Under this scenario, Tuvalu's government could operate digitally, maintaining administrative and diplomatic functions. As scholars emphasize, these operations challenge traditional notions of governance being tied to a physical location as codified in the Montevideo Convention.

Finally, scholars in international relations and political science question how the capacity to enter relations with other states is challenged by Tuvalu's battles with SLR. Historically speaking, achieving diplomatic recognition involves physical cooperation, face-to-face participation, and in-person discussions among states [35]. However, academia has suggested that the conventional nature of diplomatic relations is changing as digital technologies enter international relations [35]. As indicated by the COVID-19 pandemic, online diplomatic interactions have reconstructed state relations from "face-to-face interactions to digitally mediated synthetic situations" [35]. These normative changes could benefit Tuvalu, as expanding diplomatic engagements make it essential to uphold its sovereignty [35].

State Preservation in the Digital Age

Historical Applications of Technology to Leverage Sovereignty in Tuvalu. While the potential loss of physical territory challenges traditional criteria for statehood, it necessitates innovative approaches such as digital sovereignty. Tuvalu's international advocacy, legal innovation, and digital twin highlight the need to rethink how statehood and sovereignty are understood within global environmental change. However, leveraging digital initiatives for sovereignty is not new in Tuvalu. In the 1990s, the International Telecommunication Union was assigning country code top-level domain names (ccTLDs), or country codes, in which Tuvalu acquired the ccTLD '.tv' [42]. With this name came Tuvalu's exclusive rights to this Internet

domain name. Tuvalu capitalized on .tv since it is the worldwide abbreviation for “television” [43]. After several contracts with foreign companies, Tuvalu began profiting from .tv in 1998 by leasing the address to interested service providers [43]. Increasing competition for this domain name spurred Tuvaluan leaders to leverage their Dot TV domain name as a potentially valuable financial resource [42]. In 2001, Tuvalu settled an agreement with network infrastructure company VeriSign Inc., in which the .tv domain was opened to all businesses [43]. Under this agreement, .tv became licensed to 485,195 websites, including the popular gaming website Twitch [43]. Twitch operates as a multi-billion-dollar platform, generating additional revenue streams for Tuvalu [43]. By June 2014, .tv had the tenth-largest number of registrations for a ccTLD [42]. Given such benefits, scholars argue that Tuvalu has become a “reasonably good trustee of the .tv asset, returning a steady income and doing no apparent harm” [44].

However, Tuvalu’s role as a trustee is situated within broader tactics of small states and territories commercially leveraging their jurisdictions [43]. Methods such as flags of convenience, passport sales, and citizenship schemes continue to raise concerns in regional, local, and international forums [43]. Tuvalu has pursued many of these alternative sovereignty-related revenue generators, including passport sales, international shipping registers, fishing rents, and sales of Tuvalu telephone numbers to phone sex operators [43]. The latter pathway generated some revenue; however, the Tuvaluan public expressed disagreement, cancelling this Aus$2 million/year contract [43]. Additionally, until 2000, the Tuvalu Trade Mission in Hong Kong was marketing passports at US$11,000 for individuals and US$22,000 for families of four [43]. With this passport, holders could reside in Tuvalu; however, bad publicity terminated this practice [43]. Despite their contentious natures, these pathways have generated additional sources of economic sovereignty, although not as lucrative as Dot TV.

Digital Tuvalu as Situating Statehood and Strong Climate Diplomacy. As a result, Tuvalu's rich history with technology and alternative sovereignty has manifested itself in the nation's contemporary initiative of Digital Tuvalu. In November 2022, Tuvalu announced the creation of a "digital twin" as a virtual representation of its islands, culture, and governance. Echoing actions taken by its Pacific Island Countries and Territories (PICTs) counterparts, Tuvalu aims to diversify its economy through increased digitization and financial technology—an environment Digital Tuvalu uniquely positions itself within [44]. As the third initiative in Tuvalu's Future Now Project, this initiative "encompasses efforts to digitize all government administrative services and establish digital archives of Tuvalu's history and cultural practices to create digital nations" [8]. Activities include conducting digitization activities to create a digital government administrative system, aligning these platforms with intellectual property law, and ensuring that Dot TV cannot be retired even if Tuvalu's physical territory is lost [8]. Digitized government services would ensure cultural, economic, and political preservation under possible relocation scenarios while enhancing the digitization of historical documents and artifacts that would be physically lost in climate-induced disasters [8]. As demonstrated by the UN Country Implementation Plan 2023-2024 for Tuvalu, this nation upholds its position as a global leader in climate change action through the world's first Digital Nation [44]. Further, the creation of a digital twin aims to answer the following question: "What will Tuvalu do if it gains recognition of its statehood as permanent, but its land territory is lost to SLR?" [45]. With this question in mind, the Tuvaluan government proposed the Digital Nation as an alternative for maintaining sovereignty and cultural identity in the face of climate change. By preserving one's national identity, introducing digital sovereignty, extending e-governance, encouraging climate leadership, and redefining international law, Tuvalu's Digital Nation has become an innovative

response to maintaining independence when faced with the financial and infrastructural barriers of climate financing [50].

Most recently, during COP28 (2023), Simon Kofe, former Minister for Justice, Communication & Foreign Affairs, provided a global update on Tuvalu's Digital Nation. Thus far, Tuvalu has completed a comprehensive three-dimensional LIDAR scan of all 124 islands and islets, generating a geographical foundation for the digital twin [49]. Tuvalu has begun upgrading its national communications infrastructure by installing two submarine cables [49]. The nation has also explored the possibility of a digital ID system which will leverage blockchain to connect Tuvaluans, no matter their geographical position, with government-related information [49]. They have also drafted plans to build a living archive of Tuvaluan culture by encouraging citizens to contribute personal items for digital preservation [49].

However, many gaps remain in implementation, consultation, and disclosure, as indicated by the Rising Nations Initiative proposed by the UN Global Centre for Climate Mobility. This Initiative's Tuvalu Digital Nation State program supports the nation's digitization efforts by building a new digital ecosystem rooted in "strengthened governance, administration, and connectivity structures" [56]. However, the deliverables and timelines remain vague, with goals for December 31, 2024, "to design Tuvalu Digital Nations and online engagement; public awareness and advocacy" [56]. Further, their website lacks progress reports, introducing a challenge in assessing the effectiveness of this digital initiative in the context of Tuvalu.

Challenges and Opportunities of Digitally Redefining Statehood. Tuvalu's pursuit of digital governance systems in response to the worst-case scenarios of SLR is an innovative approach to climate diplomacy that no other nation had previously proposed in such detail and scale. By linking climate-induced migration and sovereignty through cyberspace, Tuvalu is an

example for other Pacific nations and SIDS to pursue programs that prioritize self-determination, adaptation, and sovereignty. However, this idea of "going digital" is not solely limited to the Tuvaluan context [45]. Several other projects have leveraged digital transformations to climate change, but Tuvalu is the first to link technologies with climate mobility [45]. For instance, the Pacific's Solstice AI project uses artificial intelligence to identify and forecast renewable energy generation sources into future grid networks [46]. Additionally, Sentinel Asia was launched for disaster management in the Asia-Pacific region using space technology [46].

Such efforts have been echoed on international forums, with UNESCO creating an Urban Heritage Atlas that leverages digital technologies to conserve historical cities [57]. UNESCO aims to better manage historic urban areas by identifying, documenting, and mapping 10 Heritage Cities in Mauritania, Eritrea, Spain, India, Tunisia, Mexico, the United Kingdom of Great Britain, Northern Ireland, Uzbekistan, Mali, and the United Republic of Tanzania [57]. Archival conservation with technological tools has been pursued in Nigeria, Italy, and Portugal, where universities, municipal governments, and archaeological institutions have digitized cultural artifacts, modern art, and historical ruins using 3D scanners and local consultations [58, 59, 60].

In the Caribbean context, Barbados is on track to become the first sovereign nation with an embassy in the metaverse [47]. The nation is partnering with metaverse companies, such as Decentraland, Somnium Space, and SuperWorld, to establish digital sovereign land [47]. This will assist in identifying and purchasing lands, generating virtual embassies, facilitating 'e-visas,' and constructing teleporter features [47]. Despite the inherent ambiguity and uncertainty towards such digital applications, this example shows how Barbados is expanding its diplomatic presence by using technology to recognize digital sovereign land. Echoing Digital Tuvalu, the project

inspires other nations to retain legal counsel and set unique precedents for redefining sovereignty in the face of climate change. Hence, the Digital Nation becomes a driver for unlocking the full potential of digital advancements across SIDS by prioritizing inclusive digital governance [48]. Centring policies around accountability, equity, and human rights will assist Pacific SIDS in navigating uncertain futures perpetuated by climate change [48]. However, unequal access to technology can risk deepening existing inequalities, hindering SIDS' social fabric [48]. Given this geopolitical diversity, digital solutions must adopt a nuanced perspective that considers legal, ethical, social, economic, and cultural implications across present and future scenarios [48]. I plan to adopt this comprehensive and interdisciplinary perspective throughout my paper.

Methods

Researcher's Positionality Statement

As argued by Kristina M. Scharp & Lindsey J. Thomas (2019), social science scholars should consider their own biases, positionality, and reflexivity when conducting research [61]. As an undergraduate researcher at McGill University in Montréal, Canada, I approach my project with an awareness of the standpoint and privilege associated with my background. Studying in an industrialized country that continually pushes back against constructive climate action, aid, and financing, I recognize the disparities in lived experiences and the uneven distribution of global climate impacts.

My position as an outsider necessitates a commitment to honesty, transparency, and respect for Tuvaluan values, traditions, governance, heritage, and politics. I strive to understand this region's participation in climate change negotiations through active listening and collaboration with the participants who have volunteered their precious time and effort to speak

with me. In having these open conversations, I hope to bring awareness about Tuvalu's call for polluter responsibility and climate action to limit global warming.

However, I acknowledge that my position as a non-Tuvaluan researcher has influenced this project's methods, findings, and discussion. I am cognizant of the potential for research to reproduce "colonialities of knowledge production," particularly in the context of climate discourse surrounding SIDS and LDCs [62]. To mitigate this, I am to incorporate the work of Tuvaluan researchers, students, and scholars in my discussion section, to ensure that my work amplifies the nation's efforts. Keeping this at the forefront of my mind, I consider biases originating from myself, participants, and the archive of science-based research that posits climate change as a justice-oriented issue.

I want to clarify that my role is not to speak for Tuvalu but to support the perspectives, voices, and experiences of those who have chosen to participate in my project. Through my research, I would like to bring attention to the impacts of SLR, while contributing to the creation of academia that respects each nation's right to preserve its culture and combat climate change. I am committed to conducting research that benefits policymakers and stakeholders in Tuvalu, ensuring that my findings are shared transparently.

This work is both a responsibility and a privilege that necessitates ongoing reflection. In writing this positionality, I am reminded of former Tuvalu Prime Minister Enele Sopoaga's words, "If we save Tuvalu, we save the world" [63]. I carry this moral imperative and strategic call for global responsibility and climate justice with me throughout this thesis, as I believe it underscores the ethical dimensions of climate action. By incorporating these voices into my research, I hope to shed light on Tuvalu's climate governance and international relations in an ethical, just, and empowering manner.

Research Design, Data Collection, and Analysis

This case study was undertaken as part of a two-fold methodology encompassing a detailed literature review and thematic analysis of semi-structured interviews. As demonstrated in the literature review above, I conducted a qualitative data analysis of scholarly literature from journal articles and periodicals, as well as grey literature in project briefs, national policies, and international law to investigate the recent advancements in Tuvalu's response to climate change and SLR. Documents included Tuvalu's National Adaptation Programme of Action (NAPA), Tuvalu Coastal Adaptation Project's (TCAP) project documents, Tuvalu's Fourth National Communication to UNFCCC, Tuvalu's National Strategic Action Plan for Climate Change and Disaster Risk Management (NSAP), and Tuvalu's National Climate Change Policy (NCCP). Complemented by existing international laws and legal scholarship discussing *ex-situ* statehood and deterritorialized sovereignty, this literature review highlights Tuvalu as a symbolic example of SIDS' need for effective climate governance, urgent adaptation, and equitable digital solutions [51]. This component of the case study was conducted from September to November 2024.

Drawing on the growing adoption of interdisciplinary research methods in the Pacific, 15 semi-structured interviews were conducted. Adopting a mixed-methods approach [64], these interviews were critical to obtaining insights from key stakeholders with knowledge or expertise about Tuvalu's perspective on climate change, digital statehood, and environmental law. Participants included academics from universities in the Pacific, representatives from sea-level rise modelling projects, regional experts in climate change adaptation, representatives from Tuvaluan NGOs, global climate change researchers, Pacific-based environmental activists, and environmental sustainability officers.

Qualitative data was collected by thematically analyzing the 15 semi-structured interviews. To streamline this thematic analysis, an interview guide was used with questions across four different themes: background on sea-level rise in Tuvalu (such as SLR's impact on Tuvaluan infrastructure, economy, and livelihoods); Tuvalu's statehood and sovereignty (such as amendments to the nation's constitution and the role of international law); the Digital Tuvalu initiative (such as the vision, goals, public perception, and infrastructure required for the project); and long-term visions and challenges (such as the sustainability of a digital state and how Tuvalu aims to position itself as a leader in digital statehood). Participants were provided with these guiding questions before the interview to gauge interest and ensure transparency. Interviews combined a flexible, conversational approach with this guiding framework of prepared questions to ensure the exploration of new ideas that arose during the discussion. Participant agency was prioritized, as those who did not feel comfortable answering certain questions were not required to do so. Participants were encouraged to share their perspectives, uncovering nuances that might be missed in more rigid methods. Given my paper's investigation of diverse perspectives and context-specific knowledge in SIDS, semi-structured interviews provide a holistic understanding of the relationship between SLR and Digital Tuvalu, building on existing literature.

These conversations, ranging from 45 minutes to an hour, were conducted and recorded via Microsoft Teams. The interview transcripts were uploaded to Microsoft OneDrive and analyzed thematically using inductive coding across these four broad categories. Given that climate change, SIDS and Digital Tuvalu are contested and debated topics, all personally identifying information, such as name and contact information, was removed. The project received human research ethics clearance through McGill University's Research Ethics Board (REB File Number: 24-09-034).

Results

After conducting interviews with participants, five key themes emerged, each providing valuable insights into the relationship between digitization, statehood, and climate change-induced SLR in Tuvalu. A detailed thematic analysis of participant responses reflects commonalities, unique perspectives, and recurring patterns that expand beyond current academia's focus on legal jargon and geopolitical boundaries. They encapsulate the implications, priorities, and limitations of Tuvalu's response to climate change while serving as a framework for understanding collective viewpoints on digital initiatives and climate action. This thematic analysis not only highlights shared experiences but also underscores the inherent nuances in individual perspectives, offering a comprehensive understanding of the current and future relationships at stake for SIDS, such as Tuvalu, when faced with SLR.

The first theme concerns the key considerations for implementing effective digital strategies for sustainable adaptation and mitigation of climate change-induced hazards such as SLR. As participants emphasized, in the context of Tuvalu, four components—adaptive leadership, assertion of national agency, continued international support, and transparent community consultation—are required for the holistic development of technology as a tool for responding to climate change in a way that upholds Tuvalu's autonomy and history. Within this theme, participants highlighted the need for drawing upon past examples, such as e-Estonia, Banaba Island (also known as Ocean Island), and the Girmitiyas population in Fiji, to develop a systematic approach for "state-preservation" rather than "state-building" [70]. This theme will be elaborated on in the discussion section to highlight how each of these three examples acts as building blocks for Tuvalu's pursuit of a digital state.

The second theme leverages these four key ingredients for digital state preservation by positioning Digital Tuvalu as a double-edged sword—an initiative that brings several risks and uncertainties while acting as a strong tool for advocacy. As participants highlighted, the highly controversial and contested nature of Digital Tuvalu speaks to the greater polarity of climate change discussions concerning international recognition, sufficient financing, and global cooperative action. With opinions on Digital Tuvalu ranging from a "flash in the pan" initiative to a "valuable asset" for managing climate impacts, the idea of a virtual nation-state is contested within conversations of establishing material and cultural archives that truly represent Tuvaluan livelihoods [71, 72].

However, the third theme extends this duality to position Digital Tuvalu as reshaping the climate change imaginary in 2 ways. As participants emphasized, the abundance of Western literature discussing SLR, climate mobility, and relocation centers on victim narratives, which silences and generalizes Tuvaluan voices. However, Digital Tuvalu resists this popular imaginary of SIDS as climate victims by attempting to translate mobile forms of sovereignty into the digital realm. Second, the Digital Tuvalu initiative reflects a broader discursive shift occurring as Tuvalu explores new strategies for responding to climate change in a way that garners international attention while also maintaining independence and autonomy in decision-making.

The fourth theme expands on advancing responses to climate change by outlining how Tuvalu's attempts to archive cultural and material assets in Digital Tuvalu speak to how cultural heritage and practices are intangible. As participants highlighted, this initiative extends beyond record-keeping and archival research to incorporate discussions of immigration, ceded land, and

relocation. Consequently, this theme incorporates the nuanced perplexities of digital statehood to emphasize how SLR affects more than just sovereignty.

The final theme emerging from semi-structured interviews broadens this paper's lens to focus on how ethical justice and intellectual property are tightly linked to sovereignty, especially in the face of climate change and Tuvalu. Participants positioned climate change as a colonial force in and of itself that concerns human rights violations and neocolonial orientations. As such, this theme points to the international community's responsibility to SIDS for its unequal contribution and impact on accelerating climate change. Current Western-oriented legal mechanisms and international relations are insufficiently equipped to deal with the accountability associated with climate change and statehood. As participants emphasized, the current academic landscape is situated on Western notions of relocation, climate mobility, and refugee status. This "canaries in the coal mine" rhetoric creates a hopeless and victim-oriented narrative that all participants expressed an urgency to push against in their work [65, 66, 67, 68, 69]. Instead, as this thematic analysis indicates, a shift is underway—one that prioritizes centring Pacific voices by highlighting Tuvaluan traditions and reimagining climate change adaptation as an initiative that emphasizes the ethical and responsible use of SIDS data.

As I will elaborate further, I position these five themes as working together to reframe Tuvalu's response to SLR by intervening in global climate discussions with a sense of urgency, agency, and accountability. However, as the discussion section below suggests, this thematic analysis is not exhaustive but rather reflective of the sample of participants interviewed. As such, these insights should be interpreted as indicative rather than definitive, and they may not fully capture the breadth of Tuvalu's response to climate change. The geopolitical, cultural, ethical, and economic complexities of sustainability-driven conversations in Tuvalu have generated

many differing external and internal opinions on mitigation, adaptation, and digital initiatives. Consequently, an accurate representation of these complexities cannot be entirely or easily captured by the interviews conducted; however, they can be explored in further research, as mentioned later in this paper.

Discussion

Theme 1: Digital Strategies for Sustainability Require Adaptive Leadership, National Agency, International Support, and Transparent Community Consultation

The first theme emerging from semi-structured interviews concerns key considerations for effectively implementing digital initiatives such as Digital Tuvalu. Participants emphasized how the real-world development of this technology in response to climate change hazards, such as SLR, requires adaptive governance, national agency, international support, and transparent community consultation. This section will elaborate on the varying perspectives towards these key considerations, as each contributes differently to the pursuits of state preservation in Tuvalu.

Adaptive Governance: Leveraging the Historical Successes of e-Estonia, Banaba Island, and the Girmitiyas Population in Fiji. As several participants argued, a systematic approach, drawing from past examples of displacement, relocation, and digital governance, will prove particularly suitable for digital forms of state preservation that uphold agency, nationhood, rights to marine territory, and cultural heritage associated with the land [79, 87]. Two key case studies emerged in semi-structured interviews: Banaba Island (Ocean Island) and the Girmitiyas population in Fiji. One participant involved with a Pacific university highlighted that Banaba is an island with a complex history rooted in colonial pursuits of phosphate mining. Its population was relocated to northern Fiji in 1945 [88]. In this relocation, Banabans were harmed by "extractive industry, colonial map-making, and ongoing governance challenges" [119]. While

digitization was not a component of preserving Banaban culture at that time, several aspects of being an "Ocean Islander" have been recorded in books and other archival materials [88]. For instance, the Rabi Island Community Hub and Banaban Human Rights Defenders Network serve as platforms for cultural expression and preservation amidst displacement [120]. This case study is relevant to Tuvalu since, even though the connection to physical land has been severed from displacement and dispossession, the population has still forged pathways for maintaining Banaban culture and identity [88].

A second case study of the Girmitiyas population in Fiji proves especially useful as this population crossed two oceans when the abolition of slave labour in the early 19th century gave rise to the Indian indenture system [121]. Under this system, Indian labourers were recruited from British India to work on sugar plantations in Fiji from 1879 to 1920 [121]. After this period, many returned to India, while others called Fiji home. As a participant involved with a Pacific university emphasized, the Indian culture began to disappear in Fiji. However, digitization plays a strong role in preserving linkages to Girmitiyas ancestors for present-day populations as living museums and storytelling have been leveraged in digital databases [121]. Specifically, the Girmit database has digitized Indian Immigration Passes from the National Archives of Fiji to create records that show descendants of the original labourers' history [122]. As a knowledge base and research tool, this database has helped thousands of people trace their heritage through archival documents and rare images [122]. This case study shows that every "single island state, in some way, shape, or form, is engaging with the digital" through AI, digital training, digital ecosystem development, and national digital IDs [79].

However, as one participant—a senior researcher in international relations—argued, Digital Tuvalu differs from these previous case studies since the initiative is "not so much about

virtual state-building but more about state-preservation" [70]. Past developments often focused on state-building for innovative diplomatic relations and communication technologies [70, 117]. For instance, in e-Estonia, 99% of public services are available online 24 hours a day, making e-governance a “strategic choice that improves the competitiveness of the country and increases the well-being of its people” [118]. As the senior researcher mentioned, through digital identity, secure data exchange, and high-quality databases, e-Estonia reflects early instances of states trying to outsource some governance functions to virtual realms [70]. However, these previous real-world developments in virtual states differ from Digital Tuvalu.

With the added element of climate change, Digital Tuvalu is generated and driven by Tuvaluan actors, cementing itself as an innovative and unprecedented project [70]. As such, the initiative situates itself within broader Pacific climate discourses, which have an “adept skill in accepting external interests and turning them into home-grown initiatives” [116]. Hence, the purpose of these examples is not to generalize digital sovereignty as a concept, but to highlight how successful case studies exist across geopolitical contexts, which Tuvalu can leverage for future endeavours in digital state preservation.

National Agency and Community Consultation: Successful Digital Implementation Requires Tuvaluan Decision-Making. The second and third elements identified as important for successful digital strategies are interconnected as a national agency and community consultation emerge through Tuvaluan decision-making and leadership. Given that the “local community was not consulted on Digital Tuvalu,” there is an immediate need for engagement across the islands [86]. This lack of consultation and collaboration has resulted in a polarized conception of the initiative, with “some negotiators thinking it is foolish, while others believing there are benefits” [86]. Consequently, engagement across Funafuti and the outer islands requires

active efforts to discuss pathways forward with *Falekaupule* (the traditional assembly of each island) and NGOs through participatory workshops and community meetings [86]. Throughout the entire lifespan of Digital Tuvalu as a project, "Tuvaluans need to be leading the charge" and "confirmation must come from Tuvaluans themselves" [86, 88]. Here, community engagement plays an integral role in consulting those most impacted by SLR on the perceptions, feasibility, and acceptability of an initiative like Digital Tuvalu [91]. Hence, the effectiveness of successful digital implementations rests on purposeful knowledge co-production with Tuvaluans, as the initiative's goal of "cultural preservation cannot be effectively achieved without the physical community's input" [87].

However, as one participant, a digital strategy program manager, mentioned, many island states experience a "brain drain" in which skilled workers from Pacific Island nations migrate to other countries, leaving their home country behind [79]. This means that digital initiatives cannot place the sole burden on citizens to collect elements of cultural preservation and geographical mapping [79]. As one participant, an environmental consultant in the Pacific, argued, "For the Tuvaluan identity to survive, we need to be adaptable and bring new knowledge and technological and economic means" [103]. In this regard, resiliency rests on the circularity of national leadership and local engagement since those seeking educational and professional opportunities elsewhere have a unique opportunity to bring their skills and knowledge back to Tuvalu for enhanced climate management. As such, this circularity "empowers Tuvaluans to be a part of the solution" [103].

International Support: Successful Digital Implementation Requires Global Recognition and Financing. Given that donations and funding can be complicated for SIDS, the final concern mentioned by participants stemmed from international support for the legitimacy of

virtual states [71]. Here, there are two elements of international support and partnerships: 1) awareness, and 2) climate financing [86]. The first element of awareness concerns a need for the international community to recognize that climate action is urgent. Here, Digital Tuvalu operates as a call to action, overtly stating that the world cannot "just sit back and watch" how their actions are accelerating climate change [86]. As this participant argued, financing requires understanding and action on behalf of international actors that recognize how SLR is a very real threat in Tuvalu [86]. However, with increasing attention comes increasing geopolitical interactions in which external stakeholders could assert their agendas for climate adaptation.

The second element of climate financing concerns the possibility of bilateral aid in assisting digital developments [86]. Adaptation finance needs for SIDS face challenges due to limited access, complex climate financing schemes, and capacity gaps in these areas. While Tuvalu receives funding from agencies such as the Green Climate Fund (GCF) and national donors like Taiwan, Australia, and China, access and capacity-based gaps remain in implementing this funding efficiently and effectively. As such, several participants mentioned how bilateral agreements would be the "most common path for the future of Tuvalu in terms of funding," given the significant investments needed for climate change adaptation and mitigation across islands [81]. As one participant, an adaptation specialist, argued, "Currently, there is no international mechanism" to support the level of funding needed for effective adaptation [81]. International pools of financing, such as GCF and the Loss and Damage Fund, are very complex, lengthy, and limited in scope.

Similarly, a digital nation introduces complexities to international recognition of statehood and sovereignty. One participant, a managing partner for an NGO, questioned international ramifications when they asked, "Can you push that digital representation [Digital

Tuvalu] into something that can be recognized as a sovereign nation?" [72]. This question, like many others, necessitates a conversation around the current interactions between international relations and sovereignty. However, as one participant, a former employee of Tuvalu's Department of Foreign Affairs, argued, international law starts at the bilateral level [89]. This argument stems from the idea that if enough countries sign an agreement, such as a communique acknowledging Tuvalu as a country regardless of physical territory, international change will happen [89]. This is already being done as 26 countries, including Australia, New Zealand, and 16 other members of the Pacific Islands Forum, have recognized Tuvalu's digital sovereignty.

Theme 2: Tuvalu's Efforts in Digital State-Preservation as a Double-Edged Sword

As many participants emphasized, "Digital Tuvalu highlights the potential of digital innovation, but there remains complexity and uncharted territory" [79]. Here, technology is a double-edged sword that interacts with "definitional aspects of territory that are still based in material notions of ownership" [79]. This disconnect between formal definitions and local understandings of sovereignty presents a tricky sociopolitical landscape in which one can "protect and champion heritage to new audiences, but risks eroding it with the connectivity of today's environment" [79]. As this section will emphasize, Digital Tuvalu positions digital state preservation as a valuable asset for island documentation, while also introducing questions of taxonomy, technicality, economics, and sustainability.

Digital Tuvalu as a "Flash in the Pan" Initiative. Some participants expressed the Digital Twin initiative as a "flash in the pan" proposal introduced to the Tuvaluan government but ultimately subsided once the Prime Minister and Cabinet rotated out [71]. Amongst these participants, Digital Tuvalu was an idea from the former Foreign Minister for Tuvalu, Simon Kofe, that is not widely accepted or understood. As one participant—a climate scientist,

diplomat, and educator—argued, Simon Kofe has been replaced as the Foreign Minister, along with the traction gained from Digital Tuvalu [71]. This argument is emblematic of the many ideas floated at side events and international conferences, in which ministers are presented with ideas but remain unacted upon as the government's composition changes [71].

As a Digital Strategy Program Manager echoed, there are many stakeholder agendas and exogenous factors behind Digital Tuvalu [79]. Consequently, the geopolitical, economic, and cultural factors driving each of these multipliers complicate this initiative's progress. Currently, the lack of publicly available information on a detailed timeline or financing advancements for Digital Tuvalu resonates with participants' emphasis on how "silence can go both ways" [79]. While the project rose to the forefront of international discussions in 2022, the current silence and general uncertainty amongst participants about its status show that either much is happening behind the scenes or that the project has stalled. Following this thought, it becomes increasingly difficult to determine whether Digital Tuvalu is being deployed as a tool for asset management or merely remains a "flash in the pan" initiative for international attention [71].

Such hesitancies are echoed in participants' emphasis on Digital Tuvalu's technical, accessibility, and security concerns. One participant, a manager for international studies projects, stated that logistical challenges include budget constraints and practical uncertainties of critical security [86]. Cybersecurity becomes a crucial issue in determining the level of access and interactivity given to different users, such as Tuvaluans and non-Tuvaluans. One participant involved with a Pacific university asked: "If multi-million-dollar companies cannot even protect their data from being hacked, what is the guarantee that this data will be properly secured from data theft and piracy?" [88]. This is a key question for those wishing to advance Digital Tuvalu, as digitization becomes risky when infrastructural, financial, and knowledge requirements are

inadequately addressed. Currently, the scale of funding required for such a project is lacking [81]; there is no financial mechanism capable of addressing long-term adaptation in the "stretched budgets and stretched priorities" within the Tuvaluan government [79]. While Tuvalu has developed a National Information and Communications Technology Policy, barriers such as limited operational capacity, inadequate infrastructure, inconsistent budgets, and low cyber threat awareness across the Pacific pose threats to cybersecurity development [74]. Considering the sensitive information surrounding governance, identity, and culture that will be stored in Digital Tuvalu, the stakes are higher for safeguarding this country's digital assets [74]. As such, scholars question whether the Falepili Union should be amended to assign Australia the responsibility of strengthening Tuvalu's cybersecurity measures [74]. Consequently, Digital Tuvalu extends beyond governance risks to include cultural corruption as manipulation of digital data about Tuvaluan culture could result in misrepresentation and inauthenticity [74].

As mentioned previously, these financial and technical obstacles are exacerbated by international law's inadequacy to account for sovereignty, as its taxonomy lies in physical territory as a requirement. Since a "digital nation stretches the bounds of our current international frameworks, agreements, and laws," Digital Tuvalu becomes an uncharted landscape of human interaction, learning, knowledge-sharing, and profitability [72]. There remains an attentional challenge for Digital Tuvalu. As one participant, an environmental psychologist, highlighted, Digital Tuvalu can serve as a repository; however, expecting a culture to survive by consistently participating in, engaging with, and sharing this virtual reality remains challenging [87]. These unanswered questions regarding the security, functionality, and accessibility of a digital state are elements that the Tuvaluan government must grapple with in the coming years.

Digital Tuvalu as a "Valuable Asset" for Managing Climate Impacts. Despite these uncertainties, several participants discussed how Digital Tuvalu serves as a strong advocacy tool for Tuvaluan heritage, sovereignty, and identity. Tuvalu has a strong history of climate change activism on both national and international forums, and Digital Tuvalu is a way for the country to "stake its claim to land" [89]. One participant, a former employee for Tuvalu's Department of Foreign Affairs, emphasized that Digital Tuvalu has become a very strong stance for symbolic control over one's land, asserting that "if we [Tuvaluans] cannot save the land, we are going to save the idea of the land" [89]. While there are many debates on Digital Tuvalu as conceding to SLR and relocation, several participants contested this negative worldview by positioning the initiative as a preventative measure. In this view, the Tuvaluan government positioned Digital Tuvalu to act in ways that are not reliant on other countries. Here, Digital Tuvalu becomes a mechanism for international communication, as it represents the drastic lengths a nation must go to for preservation. As a participant mentioned, Digital Tuvalu encourages international actors to "look what we [Tuvalu] have been driven to do" as they are forced to allocate already strained resources into creating a "memory of Tuvalu" [89]. Instead of waiting for other countries to act, Digital Tuvalu feeds into the country's larger activism for land reclamation in which "Tuvalu will not go quietly into the rising sea" [90].

Other participants emphasized this perspective through their assertions of Digital Tuvalu as an innovative tool for state preservation [70], international recognition [91], climate change management [72], geographical mapping [72], and storytelling [92]. Aligning with the previous ideas of symbolic land reclamation, one participant, a professor and researcher in coastal geomorphology, positioned Digital Tuvalu as an effective timepiece for "ocean literacy and climate change literacy" [91]. By applying LIDAR technology and other geographic information

systems tools, Digital Tuvalu becomes a powerful mechanism for preserving the physical assets of an island in a way that is more visually appealing, emotive, and interactive than looking at a map [91]. For these participants, the "multi-functional and multi-faceted" nature of Digital Tuvalu positions this initiative as an accurate representation of a set of islands in time, providing valuable information for managing climate impacts [72]. One participant, an NGO representative, stated that Tuvalu is "looking into this digital virtual world as being part of the solution of the future they make for themselves" [72]. Technology can safeguard sovereignty and improve governance, extending into land-use planning and disaster mitigation efforts [92].

This was echoed in 2024 when the Tuvaluan government partnered with PLACE, a non-profit technology organization, to map the physical assets on Tuvalu's islands. Starting in April of 2024, drones were flown over the entirety of Funafuti, capturing high-resolution images of road conditions, coral reefs, water tanks, and other physical assets [93]. By using this data in software such as that made by the Environmental Systems Research Institute (ESRI), the Tuvaluan government can manage and monitor the condition and use of resources, as well as create sea-level inundation models that help identify areas of greatest vulnerability. As such, when incorporated into Digital Tuvalu, this information provides the country with "an incredibly useful asset to them in just managing the island, full stop" [72]. With a detailed knowledge of how islands work and where there are gaps, a digital twin becomes an effective tool for conversation between governments and citizens. As one participant mentioned, this interactive feature of data collection for digital twins has already been used effectively in Christchurch, New Zealand, in its rebuilding process after earthquakes in 2011 [72].

Similarly, Digital Tuvalu is a strategic bargaining chip in which international actors are forced to see what Tuvalu might become in twenty to thirty years [91]. Reflecting the

contemporary shift in Tuvalu's political strategy towards physical adaptation, one participant noted how Digital Tuvalu fits into the "nation's new focus on emergency strategy should mitigation efforts fail" [70]. Within the international context, this strategy poses a "huge challenge to existing norms of statehood and international law," as Digital Tuvalu is one pillar of the wider government Future Now Program [70]. Working in cohesion with other pillars of physical land reclamation and diplomacy, Digital Tuvalu becomes a speculative imaginary that attempts to "translate mobile forms of sovereignty into the digital realm, while linking such efforts to the claim of defending sovereign marine territory" [70].

Theme 3: The Duality of Digital Tuvalu's Reshapes Western Climate Imaginaries

Limitations in the Current Literature on Climate Change, Statehood, and SLR in SIDS. As mentioned by one participant, an adaptation specialist, Western academia is "quick to proclaim that countries will lose their sovereign territory," but there are no legal precedents or widely accepted international agreements guiding this negative assumption [81]. For this participant, "UNCLOS does not provide any mechanism or advice to generate the loss of maritime territory" [81]. However, the dominant research discourse in the Pacific makes a negative assumption about what will happen regarding the loss of territory due to SLR; "bad news travels well, and good news does not" [81]. As posited by climate mobility scholars, such as Carol Farbotko and Heather Lazrus, this perspective ignores the "positive assumption that asserts territory" regardless of climate change or any other threat and is a shortcoming of current academia that undermines island states' agency while exacerbating knowledge inequities [81]. This does not provide "commensurate care and obligation of responsibility to the countries that are of interest" [81]. This introduces an interesting argument: if academia asserts the loss of territory for small island states, it logically follows that large coastal states face similar pressures,

since “all of these countries have huge maritime territory claims...exactly like small island states” [81]. This questioning of larger metropolitan coastal states in the same way that academia questions smaller ones raises critical and underexplored issues within academia’s deterministic assumptions about SLR and territorial loss.

Given such considerations, I considered my position as a Canadian researcher and the risk of unintentionally contributing to these perceptions of inevitability. Based on these discussions, I prioritized the inclusion of a positionality statement outlining the motivations of my research. Leveraging Kristina M. Sharp and Lindsey J. Thomas’ emphasis on reflexivity in social science research, I approached this thesis with an acknowledgement of the inherent power and knowledge dynamics attached to my position as an external researcher [61]. With a conscious effort to challenge the “coloniality of knowledge production,” I set out to incorporate the work of Tuvaluan researchers, students, and scholars throughout this discussion section [62].

Digital Tuvalu: Translating Mobile Forms of Sovereignty to Resist Popular Climate Imaginaries. As several participants argued, Digital Tuvalu resists popular climate imaginaries by translating mobile forms of sovereignty into the digital realm, linking these claims to those concerning marine territory. As such, the platform’s introduction of reflection on climate change’s colonial nature pushes against popular imaginaries that situate SIDS as the first climate victims to disappear—a narrative that is not reflective of reality. Instead, one participant, a senior researcher, claimed that this integration of technology for state preservation upholds a sense of agency required for Tuvaluan nationhood, rights to marine territory, and cultural heritage associated with the land [70]. While Western literature positions SIDS as climate victims, Digital Tuvalu is situated within the country’s broader strategy to challenge ideas that the islands will disappear due to SLR, offering a vision of resilience and continuity through technology. While

critics may view this approach as overly techno-determinist, naive, or optimistic, the Future Now Program introduces a counter-narrative to the "disappearing island" framing that saturates current international discussions.

By emphasizing that mobility has always been a part of Pacific cultures and history, the initiative works towards redefining how sovereignty is exercised and defined in traditional contexts. As the senior researcher argued, mobile forms of sovereignty pose that sovereignty is not necessarily tied to physical landmasses but can evolve and respond to changing environmental conditions to preserve the identity and culture of one's nation [70]. In shifting Tuvalu's cultural, social, and political identity to mobile forms, sovereignty extends beyond physical borders to include pathways of virtual governance and political presence. As such, Digital Tuvalu becomes one example of how SIDS are reimagining sovereignty in the face of climate change since "even in worst-case scenarios, there is a form of agency to pursue" [70]. One participant, a manager for digital strategy, offered examples of e-governance through Estonia, Monaco, and the Bahamas, which have each uniquely pursued different forms of sovereignty [79]. While these instances vary widely across their application, foundations, and purposes, each challenges the static, territory-based concept of sovereignty to introduce the concept as dynamic and mobile through technological means.

Digital Tuvalu: Spurring Discursive Shifts in Climate Change Discussions. Further, the duality posed by Digital Tuvalu situates itself within contemporary discursive shifts in climate change discussions. By introducing reflections on the coloniality of climate change, Digital Tuvalu aligns itself with recent advancements in international discussions, such as the first mention of "colonialism" in the IPCC's 2022 report. This acknowledgement of colonialism as a historic and ongoing driver of the climate crisis emphasizes the rising global inequalities and

development challenges posed by a handful of privileged countries [114]. Such alignments are strengthened in Tuvalu's position as a signatory on the Fossil Fuel Non-Proliferation Treaty, which "calls for a phase-out of fossil fuels" for a global just transition [115]. In addressing the colonial roots of climate change, Tuvalu has recognized SLR as an "existential threat and developed a clear strategy for a potential scenario where territory becomes inhabitable," and not by their doing [70]. While Digital Tuvalu has received criticism from the government's opposition, Future Now has become the "first acknowledgement and acceptance that there could be a worst-case scenario," which testifies to a larger discursive shift in the Pacific region [70]. Instead, the "performative dimension of state" is shifted online, reflecting the juxtaposition of climate loss and digital transformation through nation branding and calls to action on international scales [70].

Theme 4: Digital Tuvalu is Situated Within a Broader Pragmatic Shift Toward a Holistic View of Cultural Heritage as Intangible and Intergenerational

Digital Tuvalu Faces the Challenge of Accounting for the Intangibility of Culture. As mentioned in Simon Kofe's COP28 update on Digital Tuvalu, artifacts of sentimental value, sounds of language, the wisdom of elders, dances, songs, and festivals would all be elements of culture preserved in this technological initiative [94]. Such propositions are supported by Tuvalu's National Culture Policy Strategic Plan, 2018-2024, which outlines how the Tuvalu National Cultural Centre and Museum are encompassed in the government's upcoming agenda [95]. However, the intangibility associated with each island's unique culture is challenging to capture in its entirety. As such, in international contexts, "culture falls down the list of priorities" [79]. In Tuvalu, "cultural practices are tied closely to the land and oceans," which you "cannot put a price on" [86]. The cultural considerations of loss and damage are complex, as newly

reevaluated in the Funding for Responding to Loss and Damage (FRLD) agreement made at COP28, which provides an explicit mandate to "provide support for non-economic losses" by funding the "protection of sacred sites from sea level rise, relocation of artifacts, reinforcing historical buildings, and protecting museums" [96, 97].

Despite these national and international efforts to provide a more holistic understanding of cultural practices, traditions, and beliefs, some key elements remain intangible and immaterial. As one participant, a former employee of Tuvalu's Department of Foreign Affairs, mentioned, they did not understand whether a virtual reality, archival, or museum-based perspective was associated with cultural preservation in Digital Tuvalu [89]. Given that culture extends beyond material artifacts and land masses to incorporate lived experiences and valued practices, it "comes down to whether having a virtual representation of Tuvalu would create a culture the government is trying to preserve without a physical location" [87]. Consequently, we must ask the following questions: "To what extent does Digital Tuvalu incorporate interactions between people?", "Does this virtual representation lose meaning as generations pass?", and "How does Tuvalu preserve the actions of culture as opposed to just the data about the culture?" [87]. In response to these inquiries, participants mentioned the importance of preserving culture through diplomatic conservation and digital efforts [102]. If done carefully and considerately, knowledge can be passed down from generation to generation, as "sovereignty and statehood are in our [Tuvaluan] hearts" [102]. If Digital Tuvalu moves with time through constant updates and revisions, this ever-changing understanding of culture "ensures the integrity and trueness of being Tuvaluan" [103]. However, challenges can originate in misunderstandings from external viewers on Digital Tuvalu, as demonstrated by an environmental consultant's perspective, "you will not have the touch, smell, and all the innards which are part of an existence" [103].

One participant, a manager for international studies projects, mentioned, “Digital Tuvalu becomes a chance for non-Tuvaluans to experience the [Tuvaluan] culture, but Tuvaluans need to be leading the charge” as each island has different songs, dances, rituals, and other cultural practices [86]. Important elements of identity, such as kinship and heritage, are embedded within a “taxonomy question of how to define culture,” which must be established more concretely in Digital Tuvalu as the government begins building a “living archive of culture, curated by its people” [79, 98]. As a literature and culture academic argued, “discussion about how to preserve culture should not be just manifested in preserving material goods but also needs to be preserved by way of practices and languages” [99]. Accompanied by the growing awareness and meaning of what are considered “dead items,” cultural practices are now seen as “living items” that can be propagated via technological avenues [99]. For instance, this participant cited how AI is helping revitalize Indigenous languages such as Te Reo Māori in New Zealand [100]. This demonstrates an interesting combination of Indigenous ingenuity and technology, in which Māori communities leveraged digital tools which have often excluded Indigenous imaginations in their making [99, 101]. This example speaks to one participant, a Development Officer in Tuvalu, whose perspective is that island states have “lost culture through colonization, and Digital Tuvalu deconstructs colonization to regain cultural identity” [104].

Digital Tuvalu Expands Sovereignty to Include Discussions of Migration, Ceded Land, and Relocation. Following these discussions of cultural identity, exploring relations within Digital Tuvalu begs inquiries of migration, ceded land, and relocation—subthemes mentioned by many of the participants in semi-structured interviews. For instance, an environmental psychologist emphasized how Tuvalu’s attempts to define statehood from a land-free perspective point to the roles of immigration and ceded land [87]. This participant argued

that in the context of the Falepili Union, Tuvaluans have the choice to immigrate to Australian land or choose to live on land that has been ceded to them but may not be in the best ecological condition [87]. Such concerns were echoed by an NGO's Managing Partner, who stated that currently, the climate mobility agreement with Australia does not give Tuvalu a piece of sovereign land inside Australia [72]. For Tuvaluans, "relocation is not an option," as indicated by the Pacific Climate Warrior's core message of "we are not drowning, we are fighting" [92, 106].

While this possibility of relocation was presented as a challenge to Tuvalu's future, one must also consider how "migration has always been a part of Pacific histories," as emphasized by another participant who is a climate scientist, diplomat, and educator [71]. The debate on Tuvaluan migration is complicated, as this participant provided an example of the Tuvaluans of Kioa in the Fijian Islands, who moved to this island after the Second World War in hopes of finding a settlement for future generations [71]. This island presents an interesting case of continuing one's Tuvaluan identity, as the island is owned by the People of Vaitupu in Tuvalu but operates under Fijian laws [105]. This unique story of migration and cultural preservation demonstrates how communities can bring traditions and languages to new places to maintain a strong sense of identity.

Within these conversations of migration, ceded land, and relocation, there remain important considerations on the interconnectedness of economic, social, and ecological sovereignty. As a participant involved with a Pacific university stated, SLR affects more than sovereignty to encompass Tuvalu's airport, housing, government buildings, public infrastructure, water supply, and landscape systems [88]. Climate change adaptation is not completely disjoined from economic development, recreation, agriculture, or energy generation [91].

Theme 5: Digitization Efforts in Tuvalu Must Consider Ethical Justice, Endorse Intellectual Property Rights, and Centre Pacific Voices

Finally, ethical justice and intellectual property are embedded within sovereignty as participants drew on the unequal impacts and unequal contributions of climate change on SIDS, such as Tuvalu. Within this theme, preserving sovereignty extends beyond a physical asset to include the symbolism of "having control over one's land, which is a strong stance" [89]. As this section will demonstrate, Digital Tuvalu leverages elements of ethical justice, intellectual property rights, international responsibility, and human rights to assert, "if we [Tuvaluans] cannot save the land, we [Tuvaluans] are going to save the idea of the land" [89].

Digital Tuvalu Evokes Ethical Justice and Intellectual Property Rights. As several participants mentioned, Digital Tuvalu requires careful consideration of intellectual property rights, regarding who owns the data stored and the extent of responsibility for its maintenance and security [79]. Intellectual property becomes an "important element of sovereignty," as it directly relates to how Tuvaluans' data is used, stored, and shared, both in the present and future [79]. Data sovereignty is critical since countries should have unrestricted access to information about their nations [72]. As one participant emphasized, Tuvalu does not own its satellites, so they must consult NASA and request geographic data and images [72]. This challenge echoes larger structural inequities in which SIDS lack the necessary "digital resources to plan or think about response to climate change" [72]. Consequently, Digital Tuvalu must prioritize pathways for "creating an equitable state for accessing the data this country needs" [72]. This future should incorporate key components from data ecosystems such as accessibility, data governance, security, privacy, and decentralization. For instance, one participant, a partner of an NGO, mentioned that the Locus Charter provides ten principles around the ethical and responsible use

of location data [72]. As the field of data ethics changes, the use of data in Digital Tuvalu could echo elements of this Charter, such as "do no harm," "protect the vulnerable," "address bias," and "protect privacy" [112].

Further, elements of ethical justice are evoked by Digital Tuvalu since the program acts on practical and emotional fronts to go beyond the passive acceptance of SLR. However, situated within this discourse is the very neo-coloniality of concepts such as SLR and climate change. As one participant argued, "climate change is caused by colonizers themselves," and Digital Tuvalu becomes an innovative response tied to the Pacific's fight for climate justice [89]. Tuvalu is one of the countries least responsible for climate change, but it is disproportionately affected. Digital initiatives invoke international responsibility and global awareness about "slow violence" in environmental contexts [113]. Through Digital Tuvalu, a stance is taken—the "international community has a responsibility to small island nations for the unequal contributions and unequal impacts of their actions on climate change" [91]. Through its proactive stance on preservation, Digital Tuvalu interacts with notions of "capacity sharing" to invoke how international support and action require the bottom-up development of knowledge and expertise through collaborative and relational methods [91]. Evoking feelings of guilt from developed countries, Digital Tuvalu strategically emphasizes how, without immediate action, "water will continue to come through the floorboards" [91]. According to this participant, the initiative operates as a bargaining chip since it shows foreign actors how serious the issue of SLR is for the country's economic, social, and cultural livelihoods.

Digital Tuvalu Illuminates Pacific Scholarship and Local Voices. At its core, Digital Tuvalu works towards centring Tuvaluan traditions, beliefs, and futures for the betterment of the nation. This technological pursuit illuminates emerging pathways for positioning "climate

change as a justice issue" that concerns international responsibility, local empowerment, and human rights [71]. As one participant argued, drawing on the Tuvaluan Indigenous philosophy of *fenua*, Digital Tuvalu works to link humans and non-humans through relationality [70]. Here, *fenua* "bundles community/people/places" through customary practices and territorial markers that capture the "ways in which Pacific community identity is usually linked to part of an island" [111]. This relational perspective of sovereignty and statehood serves as the basis for building a Digital Tuvalu that asserts Pacific agency in a virtual space, implicating conventional international understandings of island states as canaries in a coal mine.

As such, the use of Pacific scholars is critical for Digital Tuvalu's reorientation as local voices deconstruct "climate change as a colonial force in and of itself" [71]. In semi-structured interviews, participants emphasized the importance of work from scholars, writers, activists, and politicians involved in Pacific studies, including, but not limited to, Dr. Anita Latai-Niusulu, Dr. Carol Farbotko, Diana Hinge Salili, Epeli Hau'ofa, Dr. Gina Cole, Dr. Heather Lazrus, Dr. Jon Barnett, Jope Tarai, Dr. Karen McNamara, Katerina Teaiwa, Dr. Maxine Burkett, Mefi Naufahu, Sitiveni Halapua, and Taukiei Kitara. These Pacific perspectives serve an important role in challenging uninhabitability and immobility narratives [107], questioning migration as a mechanism for (mal)adaptation [108], investigating politics and vulnerability [109], and reclaiming Pacific-centred adaptation futures [110], amongst many more located in the University of the South Pacific Theses Database. Together, this scholarship employs creative writing, science fiction, and proactive frameworks to engage in environmental activism, centre Pacific voices, and caution against the dangers of technological solutionism. Similarly, integrating Pacific voices within Digital Tuvalu can aid in positioning this initiative as a "way for Tuvalu to stake its claim" through the development of local empowerment, international

responsibility, and physical and symbolic control of one's identity [89]. As several participants emphasized, such works must be consulted and upheld in future technological advancements across SIDS, given the influx of external investment, development, and interest in these areas.

Limitations

Due to the timing and funding constraints of this undergraduate thesis, I did not physically visit Tuvalu, which poses several research limitations for my thesis. Given this lack of in-person and firsthand observations, I acknowledge that my research relied, in part, on secondary data and literature, which might not fully capture the nuances of the discussion surrounding SLR, sovereignty, and Digital Tuvalu. Since my thesis also draws on external reports, media, and academic journals, each with its own biases, I used secondary data judiciously, ensuring the diversity and reliability of resources were prioritized. While visiting Tuvalu would have provided me with the opportunity to observe the physical effects of SLR on the islands, I contacted those working and living in Tuvalu to develop the best picture possible of the current ecological and social contexts. Conducting virtual interviews with Tuvaluan stakeholders, using video calls to build rapport, and following up with participants for feedback provided valuable insights as a primary data source.

Consequently, this lack of physical presence in Tuvalu resulted in another limitation of reduced local understanding. I acknowledge that being present in Tuvalu would have enabled a deeper and more nuanced understanding of the cultural, social, and political dimensions of SLR and Tuvaluans. Face-to-face interactions with residents, policymakers, and community leaders could have yielded more spontaneous responses than remote methods. This lack of physical presence manifested in difficulties with primary data collection, as there were limited replies to

my inquiries for discussion. For example, I had experienced difficulties contacting Tuvaluan Ministers, which prevented me from speaking with Simon Kofe, the creator of Digital Tuvalu.

Strengths of This Research

Despite these limitations, the inductive analysis of semi-structured interviews reveals how qualitative research can be leveraged to gain a complex, detailed understanding of an issue while empowering individuals to share their stories and hear their voices [73]. As mentioned, previous literature has proven useful for understanding the legal implications of SLR; however, Pacific scholars have illuminated the biases within these "sinking island imaginaries," which perpetuate "crisis narratives" and "damage-centred narratives" [68, 69, 75, 76, 77]. Conducting semi-structured interviews has strengthened such arguments by presenting how participants challenge narratives of uninhabitability that are associated with SIDS such as Tuvalu. In these interviews, diverse participants were encouraged to share their lived experiences, illuminating island voices in academic discourses that have historically isolated them [78].

Consequently, a strength of this research originates in participants' emphasis on the contested nature of Digital Tuvalu, in which Tuvalu's proactive diplomacy emphasizes fighting for land rather than territorial sinking. Despite this research's limited firsthand observations and challenges in primary data collection, those who participated in semi-structured interviews originated from all walks of life, ranging from development officials to adaptation experts. The diversity in their personal and professional experiences provided an in-depth analysis of the perspectives associated with SLR, sovereignty, and digital initiatives across Tuvalu.

Areas of Future Research

Semi-structured interviews revealed several areas that remain underexplored, presenting opportunities for future research. First, several participants expressed the prioritization of bottom-up approaches for Tuvalu's state preservation. As one participant, a manager for digital development programs, advocated, youth have been a driving force in leveraging social media and technology for climate advocacy and agency across SIDS [7]. Specifically, Digital Tuvalu becomes an opportunity to "reach digital youth through interactive digital channels" [79]. Situated within 21st-century technological innovations, these digital technologies open doors for youth-led collaboration and discussion on state preservation. However, little is known about the perspective of youth voices; hence, understanding the risks and opportunities posed by digital tools for youth is a fruitful area of future research [80].

One participant, a coastal adaptation specialist, suggested that further research could explore how Digital Tuvalu is situated within recent attempts to frame adaptation in a positive light to Tuvaluans, such as the Tuvalu Long-Term Adaptation Plan (L-TAP) and the Tuvalu Coastal Adaptation Project (TCAP) [81, 82]. L-TAP, also known as *Te Lafiga o Tuvalu* (Tuvalu's Refuge), has become the first technically feasible national adaptation plan founded on a breadth of scientific research [82]. Contrary to conventional external approaches that frame adaptation in a negative light, this document provides an uplifting view of Tuvalu's future in which opportunities and imagination are prioritized. As such, exploring how Digital Tuvalu interacts with these attempts to spur local action and reorient adaptation efforts would prove beneficial for future research.

Finally, one participant, an NGO representative, suggested that emerging applications of the Data Trust Model could sustain the long-term development of a digital state [72, 83, 84].

Following the legal structure of trusts, a data trust would assign management authority to a trustee whose responsibility is to steward that piece of data [85]. As this participant argued, one could leverage legal precedents surrounding trust law to structure a trust that protects Digital Tuvalu's data in perpetuity. This use of a data trust can make digital spaces, such as the Digital Tuvalu platform, more transparent and equitable [85]. Conducting further research could provide valuable insights into data sovereignty if Tuvalu were to scale up the Future Now program. As this participant suggested, advancing Digital Tuvalu requires retrofitting current governance systems to include precautionary measures designed around responsible and equitable data use, in which engagement with Tuvaluan citizens would be protected. However, more research should focus on defining data trust as well as implementing pilot projects for proof of concept [83]. Such scholarship holds the potential to be transferred into practical politics, bridging the gap between scientists and policymakers for effective applications of technology for climate responses.

Conclusion

This paper offers a snapshot of intersections between digitization, statehood, and climate change-induced sea-level rise in Tuvalu to argue that Digital Tuvalu challenges international law's notions of statehood and sovereignty by drawing on the Tuvaluan Indigenous philosophy of *fenua*, which links land, people, and cultural through relationality, respect, and reciprocity [7]. Tuvalu's pursuit of state preservation positions cultural heritage and physical asset mapping as complex processes that must consider diverse stakeholders, human rights, and geopolitics. In this context, Digital Tuvalu mobilizes technology to link national agencies with future pathways for navigating the uncharted waters of SLR through resilience, adaptation, and global advocacy.

As presented in semi-structured interviews, Digital Tuvalu is a double-edged sword that requires adaptive leadership, continued international support, and transparent community consultation. Digital Tuvalu becomes a new model of digital state preservation, enforcing "postcolonial island epistemologies" [7]. This repositioning speaks to themes of cultural heritage's intangibility, as well as the close links between ethical justice and intellectual property. These overlapping themes emphasize that while digitization may not offer a complete solution to SLR, it plays a pivotal role in bridging the gap between Tuvalu's present realities and future possibilities, ensuring recognition in the global arena.

Ultimately, each participant's experiences of working, living, and researching in Tuvalu call for developing intersectional approaches to climate adaptation and technological empowerment in the face of SLR. Taken together, these perspectives offer critical insights into how digitization can be leveraged by other SIDS. By exploring relations between technology, statehood, and SLR, this research underscores the significance of digital tools not just for adaptation but for reinforcing national identity in the face of uncertainty.

However, this paper contains several limitations relating to limited firsthand observations and potential over-reliance on external resources for local contextual understandings. Despite such limitations, this paper invites further exploration into how digital sovereignty can empower SIDS to assert their rights on the global stage, ensuring that their voices are heard in discussions about climate justice and resilience. Drawing on emerging literature focusing on Pacific youth voices, further research could investigate how youth expertise in digital technologies creates new opportunities for working and connecting with climate action. Therefore, international laws, policies, and arenas must recognize the efforts made by Tuvalu and SIDS alike to preserve national identities in this digital future of climate resilience.

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