Human Ecology (2026) 54:26
https://doi.org/10.1007/s10745-026-00685-2

Contextualizing future climate-forced community relocations on islands: the long history of water-related settlement mobility in Ra Province, Fiji

Patrick D. Nunn[1,2] · Tricia King[3] · Roselyn Kumar[1,4] · Binaya Raj Shivakoti[5] · Elyse Zavar[6] · Paul Geraghty[7] · Isoa Korovulavula[8] · Krishna K. Kotra[9] · Arishma Ram[10] · Seci T. Sekinini[1]

Received: 25 June 2025 / Accepted: 17 March 2026 / Published online: 28 March 2026

Abstract

Through a study of Ra Province (northeast Viti Levu Island, Fiji) involving both archival research and community engagement, we highlighted a long history of Indigenous population mobility. Many coastal settlements have mostly undocumented histories of relocating inland due to shoreline retreat and land loss over recent decades. Studies of Navutulevu and Vunitogoloa use oral histories and nineteenth-century accounts to show this. More recent autonomous relocations, identified through field surveys in Madhuvani and Navuniivi, are regarded as 'invisible' because such major adaptation responses are not usually included in most formal or published reviews of community relocation in the Pacific.

Based on our results and a broader understanding of societal evolution in the Pacific Islands region, we concluded that population mobility and settlement relocation have historically been common on (comparatively small and remote) oceanic islands, often in response to changing environmental conditions. Therefore, the possibility of future relocation might seem less intimidating for many coastal residents because of this history. The idea that future relocation is rare and therefore requires extensive funding and policy support, rooted in post-globalization norms, is inaccurate. In reality, it could undermine the resilience of Pacific Island communities by dismissing their histories of autonomous adaptation.

Keywords Water · Mobility · Islands · Climate change · Sea-level rise · Future · Ra Province · Fiji

✉ Patrick D. Nunn
pnunn@usc.edu.au

Tricia King
tking2@usc.edu.au

Roselyn Kumar
rnunn1@usc.edu.au

Binaya Raj Shivakoti
shivakoti@iges.or.jp

Elyse Zavar
elyse.zavar@unt.edu

Paul Geraghty
paulageraghty@hotmail.com

Isoa Korovulavula
isoa.korovulavula@usp.ac.fj

Krishna K. Kotra
krishna.kotra@usp.ac.fj

Arishma Ram
arishma.ram@usp.ac.fj

Seci T. Sekinini
secisekinini@outlook.com

[1] School of Law and Society, University of the Sunshine Coast, Sippy Downs, Australia

[2] Faculty of Science, University of Melbourne, Melbourne, Australia

[3] School of Business and Creative Industries, University of the Sunshine Coast, Sippy Downs, Australia

[4] School of Pacific Arts, Communication and Education, University of the South Pacific, Suva, Fiji

[5] Institute for Global Environmental Strategies (IGES), Kanagawa, Japan

[6] Department of Emergency Management and Disaster Science, University of North Texas, Denton, USA

[7] School of Pacific Arts, Communication and Education, University of the South Pacific, Suva, Fiji

[8] Centre for Sustainable Futures, University of the South Pacific, Suva, Fiji

[9] School of Agriculture, Geography, Environment, Ocean and Natural Sciences, University of the South Pacific, Port Vila, Vanuatu

[10] School of Agriculture, Geography, Environment, Ocean and Natural Sciences, University of the South Pacific, Suva, Fiji

Introduction

Climate change presents complex, interconnected, and significant challenges for humanity in many contexts. Much attention has been paid to how people can maintain or adapt their lifestyles to cope with the projected impacts of future climate change. While much focus has been on wealthier areas, far less attention has been directed toward the Global South, especially subsistence-based communities like those in the Pacific Islands region, which is the focus of our study (Allam et al., 2022; IPCC, 2022; Muiderman et al., 2023).

Over the past few decades, sea levels have risen rapidly along some of the world's coastlines, forcing many coastal communities to fundamentally change their way of life. These adaptations include various methods to manage sea-level rise and safeguard exposed shorelines, often through the construction of artificial shoreline protection structures (Bugnot et al., 2021). However, since projections of future sea levels indicate they will continue to rise, reaching levels well beyond those forecasted for 2100 (IPCC, 2023), such responses can be seen as short-term. A more suitable long-term response, which can be described as both anticipatory and transformational, is to relocate coastal infrastructure (including settlements) and activities to higher ground, thereby significantly reducing their exposure to sea-level rise (Ajibade & Siders, 2022; Duijndam et al., 2022; Petzold et al., 2023).

The issue of coast-to-inland relocation as a response to sea-level rise is increasingly discussed in resource-limited areas that cannot adequately protect coastal infrastructure and residents from rising sea levels. While well-documented examples from continental regions, especially in the Global South (Haas et al., 2021; Miller & Dun, 2019), are common, these relocations are becoming more frequent on islands, particularly low-lying ones where most people live near the coast (Adelman, 2016; Delgado & Sánchez, 2025; Simms et al., 2021). Most research on relocation has focused on externally funded programs rather than community-led, autonomous relocations (Dannenberg et al., 2019; Petzold et al., 2023). Significant attention has been given to cross-border relocations in island regions, which involve legal and political challenges. However, in the Pacific Islands, where this study is focused, most relocations have been—and likely will be—within the same country, often on the same island (McAdam 2014; Nunn et al. 2025b; Piggott-McKellar et al. 2021).[1]

To understand the challenges of localized relocation in island nations, it helps to examine their histories of human settlement. Thus, we investigate whether planned settlement relocations are genuinely new adaptive responses, as often claimed, or if they have been a recurring part of life on oceanic islands throughout history. If the latter is true, past experiences can inform how we approach and manage future relocations in the Pacific Islands and beyond (Connell, 2012; Nunn & Campbell, 2020; Tabe, 2019).

Relocation of coastal settlements on Pacific islands

Coastal communities in the Pacific Islands have relocated in the past for various reasons, including responses to (threatened) volcanic eruptions, as recently shown by evacuations from Ambae (Vanuatu) (Clissold et al., 2021), imminent land and habitability loss caused by sea-level rise, as demonstrated by the partial relocation of people from the Carteret Islands (Papua New Guinea) (Connell, 2016), and due to extreme wave damage to livelihoods, as shown by the 2009 South Pacific Tsunami in Samoa (Paulik et al., 2021).

These seem to be incidents with many historical examples, although most are inferred rather than officially recorded (Nunn 2007b, 2009b). This point is implied in the initial settlement of the Pacific Islands—when, how, and why people in the pre-globalization era reached one island group after another, eventually crossing the entire Pacific Basin (west to east) long before Europeans became aware of it (Kirch, 2000). Researchers have speculated about what motivated early Pacific peoples to explore beyond the eastern horizons, but climate pressure is likely a common factor. For example, such voyages may have occurred mostly during El Niño (ENSO-negative) events, when easterly winds were weaker (Anderson et al., 2006).

It is known that in the tropical Southwest Pacific Ocean, the period around the time of exploratory human (Lapita) voyaging (about 3300−2500 BP or 1350−550 BCE) coincided with an increase in El-Niño events, which would have caused prolonged droughts throughout this region (Carre et al., 2021; Karamperidou & DiNezio, 2022). The suggestion that drought forced the out-migration of groups of people across the Pacific region can be inferred from the tradition of 'suicide voyages'[2] in parts of the Solomon Islands and French Polynesia (Nunn 2009b; Nunn and Kumar 2024). Drought may also have been a reason for the initiation and regular renewal of long-distance inter-island voyages, such

[1] This is the reason we prefer the term 'relocation' in this paper rather than 'resettlement', which implies something top-down and contested that involves the movement of island communities to a different island/country rather than simply moving upslope/inland (locally) from their existing coastal settlement.

[2] In pre-globalization times, climate-linked food crises sometimes led some of their inhabitants to paddle out to sea, never intending to return; examples are known from the Marquesas Islands (French Polynesia) and remote Tikopia (Solomon Islands) (Nunn 2007b: 83).

as the Kula Ring (Papua New Guinea) and the *Sawei* of Micronesia (Fitzpatrick, 2008; Irwin et al., 2019) as well as mobility within a 700-km seascape in the Torres Strait and the northern Great Barrier Reef of Australia (McNiven, 2015). Drought has also been plausibly suggested as the main driver of whole-island abandonment, which explains so-called 'mystery islands' in the tropical Pacific that were uninhabited at the time of their earliest documented (European) discovery, yet showed signs of earlier sustained occupation; examples include several of the Line Islands (Kiribati) and Mangarevan outliers like Henderson Island (Di Piazza & Pearthree, 2001; Weisler, 1996).

These examples highlight the significance of water in shaping past mobility in island societies, while also revealing a deeply rooted cultural perspective that views relocation as a response to community water shortages and other livelihood pressures. Water insecurity remains a primary cause of out-migration from islands today (van der Geest et al., 2020). We chose to focus on the northeastern part of Viti Levu Island (Ra Province), where several of the authors have long-standing connections and understand how the local context can shed light on the complexities of community mobility across Pacific islands for various reasons. We utilized archival sources, including nineteenth-century accounts of the study area, along with ongoing engagement with communities and stakeholders, including open focus group discussions (*talanoa* or *baat*) conducted in culturally appropriate settings.

Ra Province, Viti Levu Island, Fiji: Historical and Future Coastal Relocations

Located in the northeast corner of Viti Levu, Fiji's largest island, Ra Province covers 1,341 km². Most of the land is upland and includes the Nakauvadra Mountains, which are renowned in many national traditions as one of the country's earliest settlement centers. The latest *Population Census for Fiji* (2017) recorded a total of 30,416 residents in Ra Province, with an estimated 70% living within 1 km of the coast. This percentage is much higher than the national average of 27.2% because Ra lacks large urban areas and inland infrastructure compared to other provinces.

Most of Ra Province, except for its southeast part, lies within the dry zone of Viti Levu Island, which exists because the dominant southeast tradewinds drop most of their moisture before reaching this area.[3] Most parts of Ra receive about 2000 mm of rain each year. Precipitation varies when the province is hit by tropical cyclones, mostly in summer, which typically form in the northwest and mainly affect the north coast of Ra. A notable exception was the severe tropical cyclone (STC) Winston (February 2016), which produced the strongest winds ever recorded in the Southern Hemisphere. It approached the east coast of Ra and caused unprecedented damage to communities along it (Nichols, 2019; Terry & Lau, 2018).

The history of Ra Province clearly shows that recent settlement movements are part of a much longer tradition of population movement. Although direct evidence is missing, it is likely that Fiji's earliest settlers, the Lapita people, settled along the Ra coast around 3000−2800 years ago (about 1050−850 BCE). Well-dated Lapita sites at Natunuku (Clark & Anderson, 2009; Davidson, 1990) and at Naitabale on offshore Moturiki Island (Nunn et al., 2007) support this suggestion. For two millennia or so after the Lapita settlement, people remained near the coast, accessing a rich diversity of food both offshore and on land. Then, around 1300 CE, a comparatively rapid cooling and sea-level fall (the AD 1300 Event of Nunn 2007a) led to ecosystem degradation and a food crisis among coastal dwellers, resulting in conflict and the abandonment of island coasts in favor of inland sites in defensible locations.[4] Evidence for this has been presented for the entire Pacific Basin (Nunn 2007b) and for northern Viti Levu Island, where Ra Province is located (Nunn, 2012). Thus, from about 1400 to 1800 CE, during the Little Ice Age, it is likely that most people in Ra Province lived inland from the coast, accessing coastal and marine food resources only when they felt safe (Robb & Nunn, 2014).

During the first half of the nineteenth century (1800–1850 CE), as European occupation of the Fiji Islands progressed, most Ra people were leaving their inland settlements. Relocations often happened due to the influence of missionaries, newly Christian chiefs, and, after Fiji became a British colony in 1874, colonial officials. However, the movement from inland to coastal areas was hastened by the widespread upheaval in Fijian society caused by large-scale mortality from unfamiliar diseases like influenza and measles (Penman et al., 2017). For his 1961 PhD, geographer Roger Frazer documented many traditions about settlement movements in Ra, although only a few are visible in Fig. 1.[5]

Frazer's extensive research in Ra led him to conclude that 25% of the settlements, both inland and coastal, had relocated due to "bad water supplies and damp" (Frazier, 1961, p. 32). The importance of water for livelihoods in Ra Province during the nineteenth century and earlier is also clear in the development of agricultural practices focused

[3] Despite this, there are clearly considerable groundwater reserves, tapped into here by the world-famous Fiji Water (Jones et al., 2017).

[4] The 'AD 1300 Event' marks the shift from the Medieval Climate Anomaly to the Little Ice Age. In the tropical Pacific, it has been associated with cooling and sea-level drops that caused a prolonged food crisis for coastal communities and led to conflicts and reorganization of settlements on most island groups.

[5] See Fig. 10 on page 32 of Frazer's PhD for the complete map.

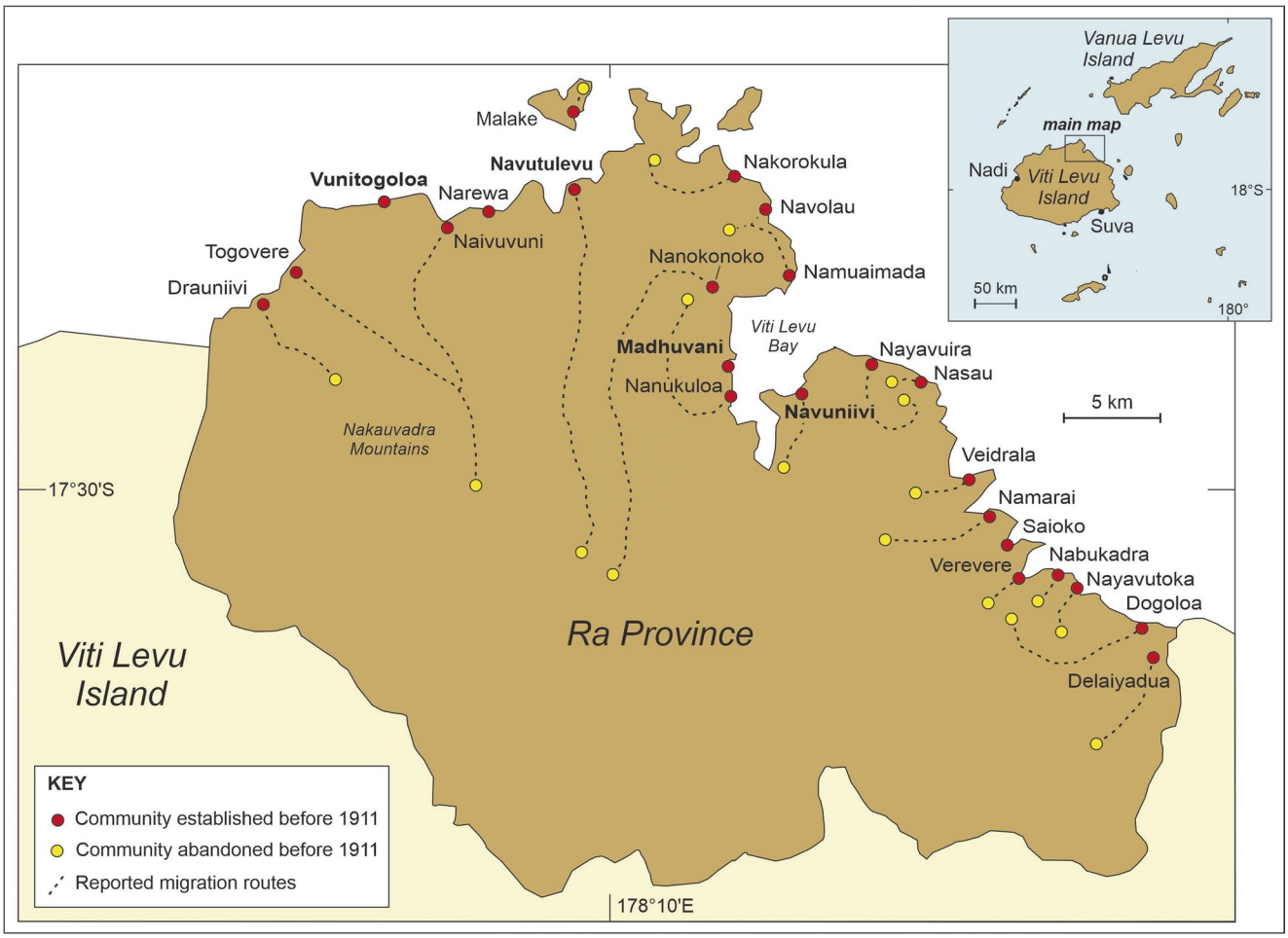

Fig. 1 Ra Province in northwest Viti Levu Island, showing selected coastal settlements from the 1911 Census and their migration routes (after Frazer, 1961). Focus sites for this study are Madhuvani, Navuniivi, Navutulevu, and Vunitogoloa. The inset shows the location within the Fiji Islands

on conserving water in these rain-shadow areas. An 1860 account describes what could be seen from the prominent rock above the village of Narewa –

> "… we proceeded to ascend the great rock which overhangs the town. We soon reached a terrace, from which there was a charming view over the gardens and plantations lying below us. There could not have been less than fifty acres [20 ha] of bananas, sugar-canes, yams and taro, on what had originally been a marsh, the water of which was now skilfully led to irrigate the ground … on small terraces we saw several patches of tobacco, and along the sides of the path and among the rocks, the greatest abundance of chili pepper bushes" (Smythe, 1864, p. 101).

Furthermore, it is argued that "the largest complex of agricultural terraces ever constructed in Fiji" (Kuhlken & Crosby, 1999, p. 63) was in Ra, along the northern slopes of the Nakauvadra Mountains. Although no longer functional today, this system was active in the 1950s, and its description by mining engineer John Fraser explains how it utilized water.

> "Lower down the slopes, near the fast-flowing water, we sometimes found the remains of terraces dug long ago for the cultivation of the water-loving taro [*Colocasia esculenta*] plants. A ditch was dug from the gully out to the point of the spur, where a long narrow terrace was built up on the sloping ground, below this another, and so on until there was a series of perhaps ten. Water flowed from terrace to terrace in an admirable irrigation scheme, and we were astonished at the immense amount of work and ingenuity represented by these systems of garden plots and water races. The terraces were often 40 or 50 yards [37–46 m] long and 10 yards [9 m] wide; and we knew that, at the time when these irrigation systems were installed, no picks

> or shovels existed in Fiji. All the digging out and leveling of terraces and water channels, as well as the construction of the trench fortifications, must have been done with pointed sticks, wooden spades, and bare hands" (Fraser, 1954, p. 173).

Such accounts highlight the importance of water conservation for Ra's subsistence livelihoods in the past and the many clever methods its people used to address water scarcity.

According to the 2017 Census, the second-largest ethnic group in Ra Province is Indo-Fijian, most of whom arrived during the indenture period (1879–1916) to work on sugarcane plantations. Most stayed after their indenture ended, and Indo-Fijian numbers in Ra increased further due to migration from the Navua area following the closure of the Vancouver Sugar Mill. Between 1921 and 1936, the Indo-Fijian population in Ra rose by 89%, compared with an average 40% increase elsewhere in the country (Frazer, 1961, p. 53). Indo-Fijians showed awareness of the threats to their livelihoods posed by water shortages and adopted many earlier Ra practices (Frazer, 1968), a situation broadly similar to that of today (Anshuka et al., 2021).

Retreating delta settlements

Today, most coastal settlements in Ra Province are located near the mouths of permanent streams or rivers. Such locations highlight the historical and ongoing importance of water in supporting livelihoods that depend on access to freshwater and nearby marine environments. Some settlements are situated along the edges of river deltas, which have expanded rapidly over the last few hundred years, mainly due to the clearing of inland or upland forests (Kumar et al., 2006). The morphology of river deltas on oceanic islands generally reflects the balance between terrestrial sediment inputs and shoreline erosion, with the latter increasing sharply along soft-sediment coasts due to twentieth-century sea-level rise and its recent acceleration (Nerem & Fasullo, 2019; Nunn et al., 2017; Salmon et al., 2019). Human settlements in such active environments often respond to these processes by relocating, but few documented cases exist in the Pacific Islands due to the lack of written records.

We identified two coastal settlements in Ra that likely relocated for these reasons, and, perhaps uniquely, oral and written records provide insights into the drivers and processes of historical relocation. These case studies are Vunitogoloa (not to be confused with the well-researched Fiji relocation of Vunidogoloa in Cakaudrove Province - McMichael et al., 2025) and Navutulevu, and their locations are shown in Fig. 1.

The name Vunitogoloa refers to the black mangrove tree (Rhizophora samoensis), with *vuni* meaning 'tree' or 'plant', *togo* (or *dogo*) meaning 'mangrove', and *loa* meaning 'black'. The name seems to have originated in the mid-1800s and replaced earlier pre-colonial names (see below), emphasizing the significance of mangroves in the area's geography (Fig. 2). The village is located near the mouth of the Wailoa (or Vunitogoloa) River, which has experienced increasingly frequent and severe floods over the past decade, including events in March 2017 and March 2024 when the entire village was submerged (Anonymous, 2017; Fiji One News Team, 2024). Such events have undoubtedly sparked discussions about future relocations (see below), but this community has a much longer history of moving, marked by the gradual encroachment of the sea onto the land. This is seen as a situation in which sediment inputs from the Wailoa River were insufficient to expand the shoreline and offset sea-level rise over the past two hundred years or so.

The earliest written account of Vunitogoloa dates back to April 1849, when Mary Wallis visited the site. She referred to it as Buladagaloa and described her visit as follows:

> "We sailed up a narrow river, walled on each side by the beautiful mangroves. After landing we crossed several dykes and at length arrived at a high fence, and apparently a strong one, being composed of large stones, mud and logs, surmounted by a lighter one of reeds. This fortification is called a "*ba-ni-valu*" [*baini-valu*] or a fence of war. We entered an opening, and found a small town of about thirty houses romantically situated in a mud puddle" (Wallis, 1851, p. 331).

Wallis described this place as "cheerless" and observed that

> "Just back of the town are several acres of fine table land, dry, and a much better locality for a town than the site now occupied; but fear of their enemies deters the people from building upon it" (ibidem, p. 331).

In 1876, two years after Fiji became a British colony, Governor Arthur Gordon visited Vunitogoloa and reported it to be

> "… a very curious little town, all cut up by canals and inlets among the houses – a sort of Fijian Venice … though the town is small and looks decayed and desolate, there were many canoes moored in the canals near the houses." (1897–1912, Volume 2, p. 617).

A year later, in 1877, Anatole von Hügel visited 'Vunitogolo' and described it as

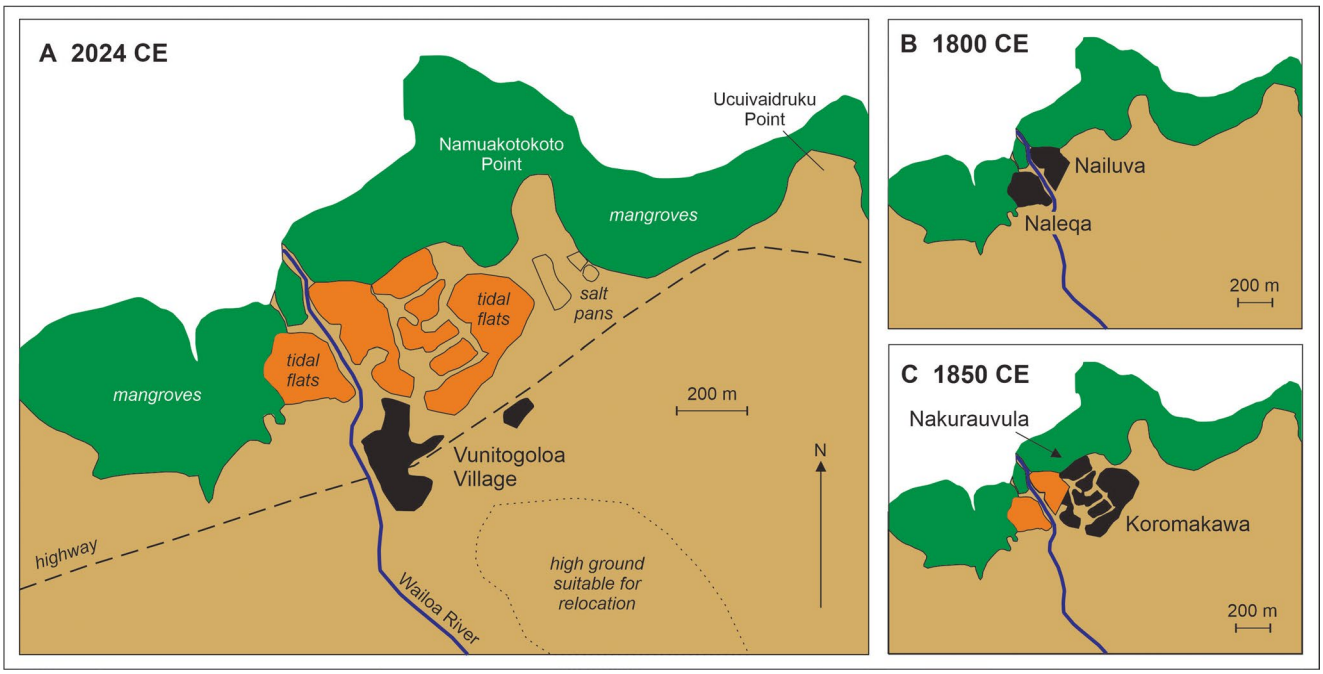

Fig. 2 Evidence for settlement relocation at Vunitogoloa. Map A shows the current situation; tidal flats are interpreted as land that was submerged within the past 200 years or so. From oral histories related by Sailosi Sekitoga and written accounts of old Vunitogoloa, the situations in approximately 1800 CE and 1850 CE are reconstructed in Maps B and C, respectively. Note that there is no information available on former shoreline positions

> "…a curious town, built in a number of separate compartments, as it were, with deep moats surrounding every two or three houses and a small stream which is spanned by a log [bridge] divides the town into two quarters. The paths, in consequence, are formed on the tops of the narrow dykes, and all this adds to the quaintness of its appearance. In the days of clubs and spears, it must have been a strong place." (Roth & Hooper, 1990, p. 267).

The picture that emerges from these three accounts is that the mid-to-late nineteenth-century Vunitogoloa was situated (as it is today) inland of the wide coastal mangrove fringe, but on a series of deltaic islands separated from one another by permanently water-filled channels connected to the main Wailoa channel. These islands were relatively small but linked to one another and the riverbanks by a series of dikes and log bridges, indicating a complex defensive settlement of the common kind known as korowaiwai (Parry, 1997). Although Gordon's and von Hügel's descriptions suggest that people had modified the Vunitogoloa they observed to improve its defenses, it is also possible that the landscape they described (which they knew nothing about sea-level rise) was a legacy of sea-level rise across once-continuous coastal lowlands.

This interpretation is supported by oral traditions shared with the lead authors in Vunitogoloa in March 2025 by Sailosi Sekitoga, whose ancestors had lived there for generations. He recalled that his great-grandfather was born in an earlier settlement he called Koromakawa, meaning 'old village,' possibly around 1840–1860, when an adjacent settlement, Nakurauvula, closer to the sea, also existed. These could be the settlements described by Wallis (1849), Gordon (1876), and von Hügel (1877), as shown in Fig. 2C. The remnants of Koromakawa are still visible today (Fig. 3A).

Even earlier ancestors of Sailosi Sekitoga lived in settlements that predated Koromakawa and Nakurauvula. On the right bank of the Wailoa River, there was a settlement called Nailuva, and on the left bank, a settlement called Naleqa, as likely shown in Fig. 2B. Although Sailosi Sekitoga was unsure whether these settlements had been separated by 'canals and inlets', he remembered that the main reason people stayed in these locations rather than on the nearby 'fine table land' was for defense. No aggressors could easily access these places, surrounded by water and hidden by a wide strip of mangrove forest on their seaward side.

Several residents of Vunitogoloa told the lead researchers in March 2025 that the village's relocation to its current site was caused by 'flooding' from both the river and the sea. It can therefore be inferred that Vunitogoloa has gradually moved inland since at least 1800 CE, likely because of coastal flooding and land loss related to sea-level rise (Fig.2). Sea level has been rising across most of the tropical (central and western) Pacific since the early nineteenth

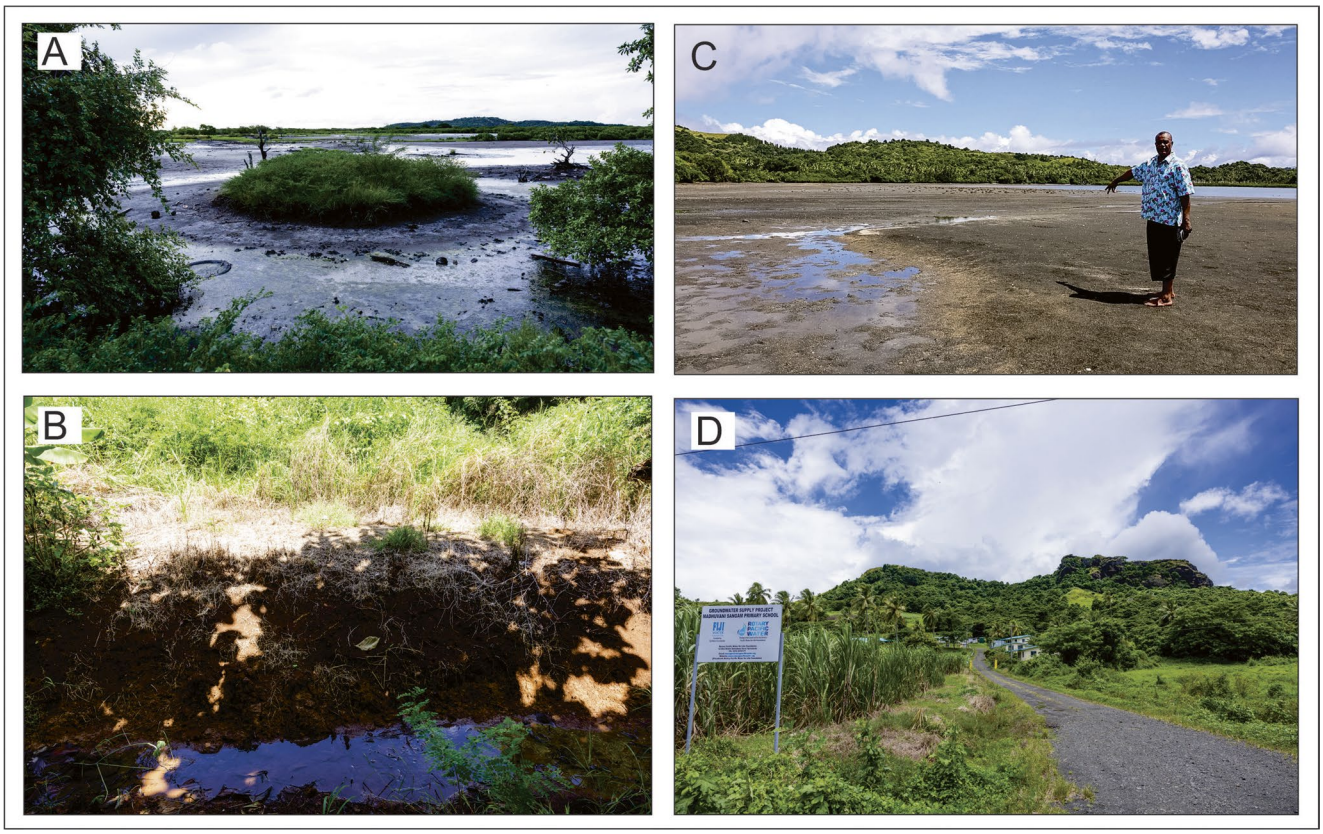

Fig. 3 (**A**) Remnants of Koromakawa just offshore of modern Vunitogoloa Village (see Fig. 2), potentially an artificial island. (**B**) Drainage ditch and possible artificial island (possibly Tova) near 'old Navutulevu,' bordering the mangrove forest seaward of modern Navutulevu (see Fig. 4). (**C**) Naca Baleisasa, indicating where a mango tree grew in the 1900s when the village of Navuniivi was on coastal flats now mostly submerged, on the south side of Viti Levu Bay (see Fig. 4A). (D) The relocated school and community of Madhuvani inland from the coast of Viti Levu Bay (see Fig. 4B)

century, accelerating into the twentieth century and continuing today (Becker et al. 2012; Church et al. 2006; Nunn 2007b). For this reason, sea-level rise appears to be a likely cause of the shoreline retreat, although land subsidence—estimated at 0.2 mm/year for the north coast of Viti Levu Island by Nunn and Peltier (2001) —may also contribute to this relocation.

Another example of a retreating delta settlement from the Ra coast is Navutulevu, located near the mouth of the Penang (Rakiraki) River (Fig. 4A). Modern Navutulevu runs along the main circum-insular highway close to Rakiraki Town, just a few hundred meters from the mangrove-lined coast that marks the eastern edge of the Penang Delta. Although slightly elevated, this area experiences occasional flooding; for example, widespread flooding occurred here in December 2016 when the Penang River overflowed its banks (Boyle, 2016).

The history of Navuniivi, the chiefly settlement in the area where residents hold land titles through family groups (*mataqali*) over large tracts of unused land, is well known within the community. Like many Fiji communities, they trace their origins to settlements in the Nakauvadra Mountains. The spokespeople for Navuniivi told the lead researchers in March 2025 about several temporary villages that their ancestors occupied during their journeys to the coast of Viti Levu Bay, where one of their earliest settlements was in the mangroves southwest of the modern village (Fig. 5A).

Although the residents of Navutulevu, whom we spoke to in March 2025, had no knowledge of any earlier settlements, it is likely that one existed during the nineteenth century and was very similar to contemporary Vunitogoloa (see above). The evidence for this comes from information provided on May 2, 1947, by Buli Semi of Rakiraki at the site of 'old Navutulevu' to Edward Winslow Gifford. (Gifford, 1951, p. 249ff) incorrectly named the place Navutolevu, an error Parry repeated (1997, p. 103ff).

The likely location of 'Old Navutulevu' is shown in Fig. 4A and in detail in Fig. 4B, with information provided to Gifford in May 1947. Principal among this information was that this 'village' consisted of 24 divisions, each surrounded by "a ditch and a hedge" (Gifford, 1951, p. 249), the latter comprising a living barrier of *wiriwiri* (*Jatropha*

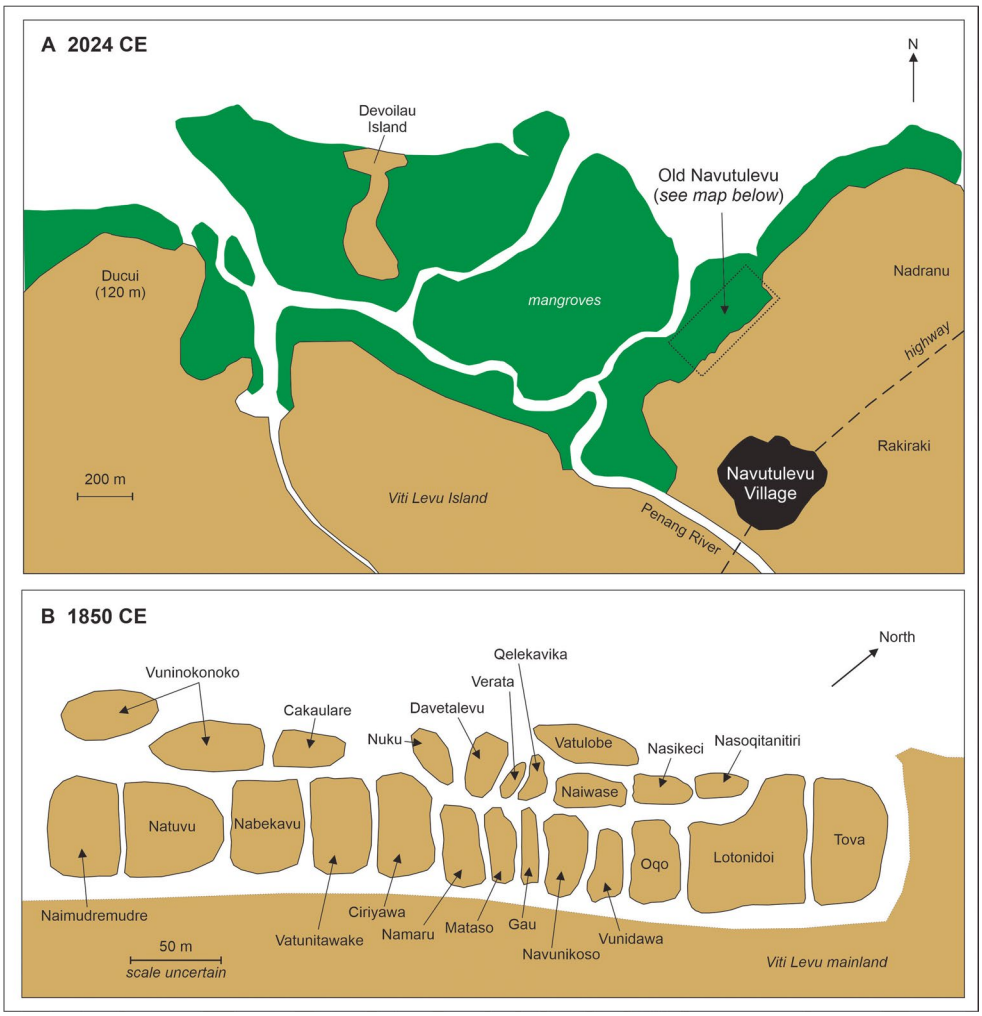

Fig. 4 Evidence for settlement relocation at Navuniivi (left) and Madhuvani (right) in Viti Levu Bay. For Navuniivi, settlement relocations start from Soevodo and the 1820 CE mangrove site to the three locations of Navuniivi in its present location on the south side of Viti Levu Bay. For Madhuvani, filled squares show the present distribution of houses and the primary school (from field survey); arrows show the approximate coast-to-inland migration routes of households, most recently in response to Severe Tropical Cyclone Winston in February 2016 (from information supplied by local residents)

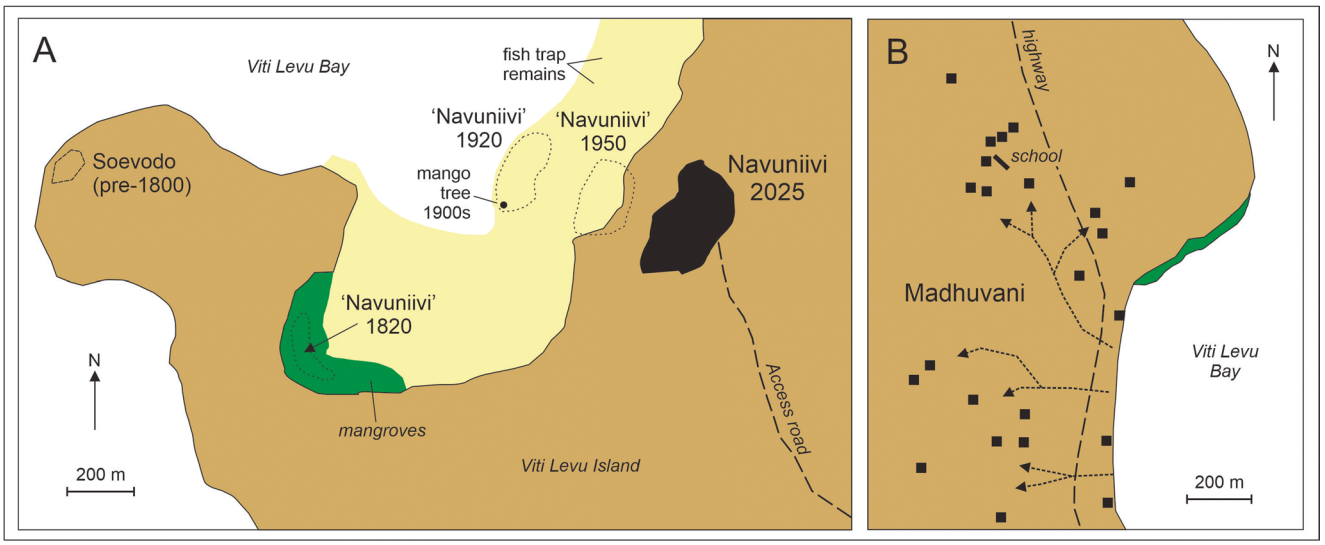

Fig. 5 Evidence for settlement relocation at Navuniivi (left) and Madhuvani (right) in Viti Levu Bay. For Navuniivi, settlement relocations start from Soevodo and the 1820 CE mangrove site to the three locations of Navuniivi in its present location on the south side of Viti Levu Bay. For Madhuvani, filled squares show the present distribution of houses and the primary school (from field survey); arrows show the approximate coast-to-inland migration routes of households, most recently in response to Severe Tropical Cyclone Winston in February 2016 (from information supplied by local residents).

curcas), known as *bai-ni-dakai* ('gun fence') when fully grown and "greatly feared" by attackers (Williams, 1858, p. 49). Even though 'old Navutulevu' had long been abandoned at the time of Gifford's 1947 visit with Buli Semi, the latter knew the names of each of its 24 constituent islands (Fig. 4B). The settlement continued to exist after the arrival of Christian missionaries in the Ra area, probably in the 1870s (Newland, 2015), for the site of the first Christian church was on Naiwase (island), while elsewhere were the sites of two 'heathen temples', according to Gifford. The site of 'old Navutulevu', as shown in Fig. 4 (and Fig. 3B), is therefore considered to date from around 1850 CE, but may have existed in this area far earlier.

Other delta settlements in Fiji are likely to have moved in the past, but their movements are poorly documented, probably because they occurred in larger, more dynamic settings. The Wailoa (Vunitogoloa) and Penang deltas in Ra are relatively small, so the remains of former settlements seaward of their current coastal areas probably stayed visible longer and were preserved longer in oral histories. In contrast, although there must have been many incidents similar to those from Vunitogoloa and Navutulevu in larger Fiji deltas, the evidence is generally less clear and more uncertain. A good example is the settlement of Bulu in the vast Ba River Delta, which in 1849 was described as being "in a swamp surrounded with mangroves which form a good protection from hostile attack" (Williams & Calvert, 1859, p. 444). The location of Bulu is uncertain today, likely because the dynamic landscape typical of such areas is constantly changing.

While undoubtedly important, the exact role of water in these relocations remains uncertain. However, the fact that both Vunitogoloa and Navutulevu moved inland along the same rivers—despite flood risks—suggests that these communities had become accustomed to livelihoods centered around freshwater and estuarine systems and could not consider changing them. It is also clear that their relocation choices were influenced by land ownership—specifically that they owned the land they moved to—and by access to services, especially proximity to a main road and piped water. This provides valuable lessons for future relocations, as discussed below. Plans that underestimate the importance of water access and availability are unlikely to be sustainable.

Recently relocated settlements

Many coastal settlements in Ra Province have already addressed coastal land loss caused by (post-1900) sea-level rise and adapted by relocating inland, typically to higher ground behind the original settlement sites. Most of these moves were community-led, lacked external funding, and were not officially recorded. This section describes two case studies of such relocations in Ra, one involving an iTaukei community (Navuniivi) and the other an Indo-Fijian community (Madhuvani) along the edges of Viti Levu Bay (Fig. 5).

One informant from Navuniivi (Ratu Meli Vakawaletabua) shared stories about an earlier settlement called Soevodo, which existed before Fiji's Cession to Great Britain in 1874 (*na gauna ena daku ni kuila*). The story states that Soevodo was the first coastal settlement established by the ancestors of Navuniivi when they reached the coast from the Nakauvadra Mountains.

At the request of colonial authorities and as the threat of warfare, which characterized the later eighteenth century and the first half of the nineteenth century in Fiji, subsided here, the Navuniivi people left their well-protected settlement in the mangroves for a coastal location a few kilometers east along the south coast of Viti Levu Bay. The district spokesman (*mata-ni-tikina*, Naca Baleisasa) of Navuniivi explained in March 2025 that this settlement was established along the edge of land that is now underwater. He pointed out a place where his grandfather remembered being told that a mango tree grew in the 1900s, near the southern end of the associated settlement, which is estimated to have been established around 1920. Shoreline erosion forced the landward movement of this settlement about thirty years later. It extended to the foot of the slopes, where modern Navuniivi now sits. Stone fish traps (*moka*) were functioning at the time of this settlement.[6]

Ongoing shoreline erosion and flooding led most household heads in the 1970s to move the settlement uphill, where it remains today. The low ground where the original settlement once was is now underwater at high tide. Severe tropical cyclone Winston (February 2016) hit Viti Levu Bay, causing unprecedented damage to Navuniivi, but, as all our informants agreed, this would have been much worse if they had not been positioned on the slope well above the storm waves. The strong wind and rain destroyed most houses in Navuniivi during STC Winston (Nichols, 2019). The Indo-Fijian settlement of Madhuvani was also devastated by STC Winston (Fig. 5B) (Elmerhebe, 2016). All the buildings of the Madhuvani Sangam Primary School were destroyed and rebuilt further inland in 2018 (Devi, 2018). Unlike most Indo-Fijians living in rural parts of Fiji, those in Madhuvani occupy 420 acres of freehold land, acquired by Swami Rudrananda for the Then India Sanmarga Ikya (TISI) Sangam in the 1940s. Although not all Madhuvani households were initially

[6] The name Navuniivi is first recorded here in census records in 1911, so earlier villages must have had other names.

located along the coast, there has been a general shift inland over the past few decades, with many households now farming sugarcane. This movement is partly due to the increasing vulnerability of coastal livelihoods caused by rising sea levels and extreme weather events that affect water, crops, and food security.

Water has been a key factor in migration decisions for the people of both Navuniivi and Madhuvani. For Navuniivi residents living in the coastal lowlands (in 1930 and 1960), the salinization of wells forced them to travel farther to find drinking and cooking water. Their decision to move upslope to their current location was partly motivated by the availability of spring water at the foot of the mountains behind the village. Today, water is piped to the community, with each household having its own tap; often, the water pressure is so high that taps are left running all night to prevent pipes from bursting. Several Madhuvani households also relocated several hundred meters inland to areas where springs emerge at the foot of rocky cliffs; here, several small reservoirs have been constructed to provide a reliable supply of household water, though issues remain regarding the ownership, distribution, and use of water sources and storage facilities.

Likely future relocations of coastal settlements

Although there has been significant community-led relocation of coastal settlements in Ra over the past two hundred years, many villages have not moved recently and are now situated in areas that are relatively vulnerable to rising sea levels and extreme waves, such as storm surges and tsunamis.

The Fiji Government has gradually relocated vulnerable coastal and riverbank communities over the past 15 years, including several along the Ra coast. According to a written response to a Parliamentary Question on April 28, 2025, severe coastal erosion at Nayavuira and Saioko hampers efforts to plan for nature-based seawalls in both locations (Rayalu, 2025). These were the subject of a funding application to the *Adaptation Fund* in September 2023, which described their worsening situations with land loss and rising sea levels (Florez, 2023). For Nayavuira, "the mean sea level is almost equivalent to the village ground level" and "the village gets heavily inundated during king tides, with seawater reaching ankle height everywhere in the village and affecting village gardens and subsistence crops" (ibidem, p. 50). For Saioko, about three meters of the coastline were lost (to coastal erosion) in the period 2005–2023 (an average rate of shoreline retreat of 17 cm/year) and,

> "the village gets heavily inundated with saltwater during high tides, storm surges and cyclones. This causes waterlogging of village compounds and takes a long time to dry out which also causes damages to the backyard gardening as a result".

At the 2023 inspection, it was observed that during high tide at Saioko, "the saltwater intrudes under eight houses [from a total of 28] and floods the village compound" (ibidem, p. 51).

Some of the coastal communities most impacted by STC Winston in February 2016 are along the Ra coast and include Namuaimada, Nanukuloa, Nasau, Nayavuira, Saioko, and Veidrala (Chaston Radway et al., 2016). Nichols (2019) provided specific data on Nabukadra and suggested that only four houses remained standing there (from perhaps 54) following the passage of STC Winston.

Sea level is projected to rise throughout the twenty-first century, potentially reaching 1.01 m above its 1900 average by 2100, according to the SSP5-8.5 scenario in the 6th Assessment of the Intergovernmental Panel on Climate Change (IPCC, 2023). Due to warming in the deep ocean and melting ice sheets, sea-level rise is expected to continue for about 2,000 more years beyond 2100, even if greenhouse gas emissions are reduced enough to slow or reverse global warming, possibly stabilizing at 2 to 3 m above current levels. Under a high-emissions scenario, it could exceed 12 to 15 m by 2300 (IPCC, 2023; van de Wal et al., 2022).

In the western tropical Pacific, sea level has been rising at rates significantly higher than the global average for over 50 years (Becker et al., 2012) likely causing disproportionately large impacts along island coasts in this region, especially in Micronesia and the Solomon Islands, which are expected to continue for at least a few decades (Nunn et al. 2025a; Palanisamy et al. 2015). A recent study on extreme sea levels (ESLs) indicates that they could be 1.8 m higher in 2100 in the western Pacific than in the baseline period 1980–2014 (Jevrejeva et al., 2023).

Furthermore, although tropical cyclones have become less frequent in the western Pacific over the past 15 years, in line with climate projections, their average intensity has increased. This trend is likely to continue, possibly establishing a new 'norm' (Knutson et al., 2020; Walsh et al., 2019).

Given that sea-level rise and tropical cyclones have long been the main causes of environmental stress for coastal communities in Ra (and other parts of the tropical western Pacific), the future outlook is worrying. The situation of these coastal communities clearly shows the need for extensive relocation of coastal settlements to inland or upslope areas. It is no longer a matter of "if we need to relocate," but

"when we need to relocate," one community spokesperson told us.

Eventually, it is likely that in situ adaptation by coastal communities, building seawalls and replanting mangroves, will be viewed as insufficient for protection. Instead, localized (upslope) relocation may become the best solution. This proactive adaptation approach could provide many benefits, including lower costs and improved human well-being. The experiences of settlements like those mentioned earlier could serve as future examples for others to follow.

Water remains a vital issue for communities relocating. Along the Ra coast, many coastal settlements are subject to extreme waves that deposit saltwater on the freshwater lens in the coastal plain, where wells are traditionally drilled for freshwater. A resident of Nabukadra described this seawater intrusion as a sign of the village's sinking; other residents linked it to the loss of the river fishery, caused by high-tide water reaching farther upstream (Nichols, 2019). In contrast, the abundant freshwater supply enjoyed by independently relocated settlements like Navuniivi and Madhuvani demonstrates that relocation can not only reduce exposure to sea-level rise and extreme waves but also greatly improve water security.

Discussion

Most reviews and studies of climate-driven relocations of coastal communities in the tropical Pacific islands assume that relocation is a new concept, caused by an unprecedented set of environmental stresses, which therefore requires complex policy decisions and costly investments (Endacott & Alam, 2023; McNamara & Des Combes, 2015; Nolet, 2016). Such assumptions are questionable in the Pacific Islands, especially given the history of relocating rural coastal communities, as in Ra Province.

Foundational role for water

Many communities in Ra today worry year-round about having enough water for their various needs. This remains a long-term issue in the tropical Pacific islands (Falkland & White, 2020), but one that has worsened over the last few decades due to globalization's spread (and the associated loss of traditional water-conservation practices) and, more recently, the increasingly reported breakdown of seasonality that makes it uncertain when or what to plant and harvest (Kassam et al., 2018; Korovulavula et al., 2020; Lykins et al., 2023).

It is argued that sustainable water supply and management are essential for supporting human livelihoods on smaller, remote oceanic islands. Survival would be impossible without them, as these islands lack backup water sources, unlike larger continental landmasses. Although traditional water security practices have been developed, they have sometimes been insufficient to prevent water shortages, leading to the abandonment of some places or islands. Highlighting the importance of water to settlement choices, many place names include references to water sources. For example, in Fiji, villages feature the words *tuvu* (meaning 'intertidal spring') or *mata* (meaning 'well') in their names.

Today, globalized 'norms' of water supply/management have penetrated most inhabited places in the Pacific Islands, sidelining traditional practices in favor of access to locally piped or reticulated water. Furthermore, while this is generally regarded as 'progress', it actually creates a new set of place-based challenges, ranging from funding/maintaining water supply (including infrastructure) to issues around water quality and sources. Before the arrival of piped water, most Pacific communities had solutions to all such challenges, ranging from unpaid community labor for funding/maintaining infrastructure (*solesolevaki* in Fiji) to knowledge about a diversity of water sources that could annul issues of localized or temporary pollution (Souter et al., 2024). Of course, it is unhelpful to romanticize such traditional knowledge, but, as elsewhere in the world, their existence underwrote sustainable place-based livelihoods for hundreds of years in the Pacific Islands (MacDonald et al. 2020; Mcleod et al. 2019; Nunn et al. 2025a).

Over the past few decades, many coastal communities on Pacific islands have become beneficiaries of novel interventions for boosting water security, such as boreholes or reverse-osmosis desalination plants, but many other communities identify the lack of sufficient water in their coastal locations to be one reason to consider abandoning them in favor of sites where more water is available (Schofield & Ojha, 2024; Sharan et al., 2021).

Water is also a driver of relocation in another sense: the encroachment of the sea across the land is an almost unavoidable driver of displacement. In the past, people in the Pacific Islands built stilt platforms with houses on them out across shallow reef flats, underwater at high tide (Hogg et al., 2022). These can be seen as having accommodated rising sea levels, allowing their inhabitants to remain closely connected to the sea. The two earliest-known human settlements in Fiji (at Bourewa and Qoqo in Nadroga Province) were both established as stilt-house settlements (Nunn 2009a). It is also possible that some of the earliest Pacific Ocean explorers were 'sea nomads' (Di Piazza and Pearthree 1999; Nunn 2007c) who lived at sea, only rarely setting foot on solid land, something which can be interpreted as an adaptation to coastal (terrestrial) change (Suhardiman et al., 2025).

Invisible' relocations

Research along the coast of Ra Province reveals many instances of 'invisible' relocation, where in the past communities relocated, apparently without any need for significant (external) funding, labor, or direction. Of course, this has not been observed only in Ra. There are many historical precedents and other examples from island contexts of "relocation self-directed through local people and decision-making structures" (Piggott-McKellar & McMichael, 2021, p. 113). However, while a few such relocations have been documented, we suggest that the vast majority have not, as the examples used in this study - Vunitogoloa, Navutulevu, Navuniivi, and Madhuvani - confirm. We learned about them through interviews with residents.[7]

The results of our approach suggest that those studying relocation in island contexts have generally greatly underestimated the numbers of these 'invisible' relocations, leading in turn to a situation in which the abilities of exposed (coastal) communities to help themselves have also been greatly underestimated. If this is correct, it has huge ramifications for how the actual needs of rural, subsistence-oriented Pacific Island communities are perceived by outsiders. For these communities are clearly not helpless or, indeed, especially vulnerable most of the time, so outsider narratives that insist otherwise are both offensive and wrong (Farbotko & Lazrus, 2012; McNamara et al., 2020, 2022). In addition, the development of frameworks and policies that are uncritically premised on such assumptions is unhelpful, as they unintentionally contribute to the sidelining of Pacific peoples' resilience.

In practical terms, the identification of at least four 'invisible' relocations in Ra Province suggests that much more research is needed on the ground in such areas to obtain a complete picture of historical/autonomous relocations of this kind. Not only would such data provide an empirical basis for understanding when, where, and why community relocations have occurred in the past, but it would also allow planners to understand better which places and peoples need more attention than others. This suggestion is in line with recent research on the comparative strengths and weaknesses of island communities on the peripheries of archipelagoes compared to those located in (near-) core areas and underscores the point that 'one size does *not* fit all' in such geographical settings (Korovulavula et al., 2020; Nunn & Kumar, 2019).

[7] We also noted the thousands of village relocations in Fiji mentioned in the *Tukutuku Raraba*, the 'Tribal Statements' collected during early colonial times, some with identified reasons for relocation.

Normalization of relocation and mobility in island contexts

Although it might sound implausible to many coastal dwellers on Pacific Islands today, there is an argument for the view that community relocation and population mobility, more generally, were normal practices here in the past. At a regional scale, extant knowledge of cross-ocean exchange networks such as the Kula Ring and the Sawei (Fitzpatrick, 2008; Irwin et al., 2019) almost certainly indicates the normalization of regular long-distance cross-ocean interactions between Pacific Islands before European arrival. Within island groups, the normalization of such interaction was also common at this time. Studies hint at this historical practice, for instance, a 3000-year-old interaction sphere in Fiji that involved over-ocean movements of people and pottery, and perhaps much more (Kumar et al., 2021). Also, within the last millennium, for example, material/lithic exchange occurred routinely within groups like the Marquesas and the Mangareva-Pitcairn group (McAlister & Allen, 2017; Weisler, 1996)

Conflict became widespread across the tropical Pacific Islands about 1200–1400 CE, plausibly due to sea-level fall and an associated food crisis for coastal dwellers (Nunn 2007b). This led to movements of people from (larger) island coasts to their interiors, as well as smaller islands offshore, where they established settlements in defensible locations; examples are documented from Timor and Fiji in the western Indo-Pacific to Rapa in the east (Anderson & Kennett, 2012; Nunn et al., 2022; O'Connor et al., 2012). These movements were commonly reversed during the nineteenth century following European settlement and colonization, a situation shown for Ra Province in Fig. 1. Coastal living in most Pacific Island nations became normalized during the twentieth century to the extent that today the prospect of moving away from the coast is rejected by most residents, even those who remember inland locations where their ancestors once lived (McMichael et al., 2021; McMichael & Katonivualiku, 2020; Piggott-McKellar et al., 2021).

Especially over the past decade, the number of (possible climate-driven) community relocations on Pacific Islands has grown, something supported both by the development of policy and procedures for relocation as well as by growth in dedicated (external) funding, especially to compensate for Loss and Damage (Dreyer, 2025; Karasov-Olson et al., 2021; Moore, 2024). These processes are expected to drive several planned relocations (or managed retreats) in many higher-island countries in the Pacific, but they will not be able to meet the demand for community relocation, because:

> "over the next decade or so … hundreds of coastal communities in the Pacific Islands will be forced to relocate, moving from places that have become

increasingly exposed to seawater inundation to places where the risk of this is significantly diminished" (Nunn et al. 2025a: 14).

If processes/funding for relocation cannot meet demand, autonomous (locally led) relocations of the kinds described above will be needed. Some research has been directed towards how to empower rural communities to help themselves relocate; one successful approach has been a 'generational retreat' whereby new houses are all built higher up the slopes behind a coastal village (Nunn & Kumar, 2019; Piggott-McKellar et al., 2021).

More important than the processes that enable future relocation is the normalization of relocation. For as long as relocation is considered aberrant (and coastal living is considered normal and sustainable indefinitely), people will resist relocation. However, once people understand that mobility of this kind has indeed been the norm in the past on (comparatively small and remote) oceanic islands, then it might become easier to accept that mobility is also necessary for a sustainable future in the twenty-first century.

Conclusion

Many policy documents issued by Pacific Island governments echo the beliefs of some scholars that relocation of vulnerable communities should be 'a last resort' option, a view commonly attributed to the costs and logistical challenges of relocation, as well as the reluctance of people to leave the places where they have stayed and developed connections, often for generations (McMichael & Katonivualiku, 2020; Nichols, 2019). Nevertheless, there is evidence that occupying vulnerable locations (coastal and riverbank areas) was not the norm in the past. Many communities that were involuntarily relocated from inland to coastal locations in the nineteenth century, for example, understood that this move would increase their exposure to weather/climate hazards, and they see the irony in now being told to move back inland (e.g., Atkinson-Nolte et al., 2021).

This study shows that mobility characterized the human occupation of (comparatively small and remote) oceanic islands prior to their incorporation into a globalized world and the introduction of the belief that coastal living was normal. Pre-globalization, mobility within and between islands was an adaptation strategy for overcoming periodic resource depletion, climate change, and the impacts of extreme events (McMillen et al. 2017; Nunn 2007b). Mobility is deeply rooted in Pacific cultures, especially the maintenance of ties between often dispersed groups, as well as the reverence for place and history exhibited by members of island diasporas (Faleolo, 2020; Freeman et al., 2023). The existence of numerous 'invisible' relocations shows that many Pacific Island coastal communities have both experience and agency in relocation, something that policymakers might want to enable in the future.

Our research also highlights the foundational role of water in the sustainability of livelihoods in the Pacific Islands. Water (or the lack of it) has been a major driver of human mobility on Pacific Islands, sometimes because people need to move due to insufficient water for their diverse needs, and sometimes because freshwater resources become polluted/salinized, threatening the sustainability of livelihoods. The centrality of water to relocations is clearly something that should feature in planning for future mobility in Pacific Island contexts (Nunn et al. 2025a).

Acknowledgements We thank the people of Ra who were extraordinarily hospitable towards the authors and generous with their time. Our key informant in Vunitogoloa was Sailosi Sekitoga, our guides through the Navuniivi district were mata-ni-tikina Naca Baleisasa and turaga-ni-koro Kelevi Mualevu.

Author contributions PDN: conceptualization, study design, investigation, formal analysis, writing. TK: study design, investigation, visualizations. RK: study design, investigation, formal analysis, writing. BRS: study design, investigation, review. EZ: study design, investigation, review and editing. PG: investigation, review and editing. IK: investigation, review. KKK: investigation, review. AR: investigation, review. STS: investigation, review. All authors read, reviewed, and approved the final draft.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions. This project was funded by three grants: "Water Security for Locally Relocated Coastal Communities in the Western Pacific" funded by the Australian Centre for International Agricultural Research (ACIAR: WAC-2022-128); "Regional Partnership for Localization of NDC through Community-Led Adaptation Innovation Hubs in the Asia-Pacific Region" funded by the Asia-Pacific Network for Global Change Research (AOA2022-01MY-Shivakoti); "Traditions of Artificial-Island Construction in the Western Pacific Islands" funded by the Endangered Material Knowledge Programme of the British Museum (EMKP-2024LG07).

Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

References

Adelman, S. (2016). Climate justice, loss and damage and compensation for small island developing states. *Journal of Human Rights and the Environment*, *7*(1), 32–53. https://doi.org/10.4337/jhre.2016.01.02

Ajibade, I. J., & Siders, A. R. (Eds.). (2022). *Global Views on Climate Relocation and Social Justice: Navigating Retreat*. Routledge.

Allam, Z., Jones, D. S., & Rooes, P. (2022). Addressing Knowledge Gaps for Global Climate Justice. *Geographies*, *2*(2), 201–203. https://doi.org/10.3390/geographies2020014

Anderson, A., Chappell, J., Gagan, M. K., & Grove, R. (2006). Prehistoric maritime migration in the Pacific islands: an hypothesis of ENSO forcing. *Holocene*, *16*(1), 1–6. https://doi.org/10.1191/0959683606hl901ft

Anderson, A. J., & Kennett, D. J. (Eds.). (2012). *Taking the High Ground: The Archaeology of Rapa, a Fortified Island in Remote East Polynesia* (Vol. 37). Australian National University E. (Terra Australis).

Anonymous (2017). Fiji's Rakiraki closed by flood waters. *Radio New Zealand (online)*. https://www.rnz.co.nz/international/pacific-news/326022/fiji's-rakiraki-closed-by-flood-waters

Anshuka, A., Van Ogtrop, F. F., Sanderson, D., Thomas, E., & Neef, A. (2021). Vulnerabilities shape risk perception and influence adaptive strategies to hydro-meteorological hazards: A case study of Indo-Fijian farming communities. *International Journal of Disaster Risk Reduction*, *62*, 102401. https://doi.org/10.1016/j.ijdrr.2021.102401

Atkinson-Nolte, J., Nunn, P. D., & Millear, P. (2021). Influence of spiritual beliefs on autonomous climate-change adaptation: a case study from Ono Island, southern Fiji. In J. M. Luetz, & P. D. Nunn (Eds.), *Beyond Belief: Opportunities for Faith-Engaged Approaches to Climate-Change Adaptation in the Pacific Islands* (pp. 247–266). Springer Nature.

Becker, M., Meyssignac, B., Letetrel, C., Llovel, W., Cazenave, A., & Delcroix, T. (2012). Sea level variations at tropical Pacific islands since 1950. *Global and Planetary Change*, *80–81*(1), 85–98. https://doi.org/10.1016/j.gloplacha.2011.09.004

Boyle, M. (2016). Rakiraki town flooded. *Pasifika Environews (online)*. https://pasifika.news/2016/12/rakiraki-town-flooded/

Bugnot, A. B., Mayer-Pinto, M., Airoldi, L., Heery, E. C., Johnston, E. L., Critchley, L. P., Strain, E. M. A., Morris, R. L., Loke, L. H. L., Bishop, M. J., Sheehan, E. V., Coleman, R. A., & Dafforn, K. A. (2021). Current and projected global extent of marine built structures. *Nature Sustainability*, *4*(1), 33–41. https://doi.org/10.1038/s41893-020-00595-1

Carre, M., Braconnot, P., Elliot, M., d'Agostino, R., Schurer, A., Shi, X. X., Marti, O., Lohmann, G., Jungclaus, J., Cheddadi, R., di Carlo, I. A., Cardich, J., Ochoa, D., Gismondi, R. S., Perez, A., Romero, P. E., Turcq, B., Correge, T., & Harrison, S. P. (2021). High-resolution marine data and transient simulations support orbital forcing of ENSO amplitude since the mid-Holocene. *Quaternary Science Reviews*, *268*, 107125. https://doi.org/10.1016/j.quascirev.2021.107125

Chaston Radway, K., Manley, M., Mangubhai, S., Sokowaqanilotu, E., Lalavanua, W., Bogiva, A., Caginitoba, A., Delai, T., Draniatu, M., Dulunaqio, S., Fox, M., Koroiwaqa, I., Naisilisili, W., Rabukawaqa, A., Ravonoloa, K., & Veibi, T. (2016). *Impact of Tropical Cyclone Winston on Fisheries-Dependent Communities in Fiji*. W. C. Society.

Church, J. A., White, N. J., & Hunter, J. R. (2006). Sea-level rise at tropical Pacific and Indian Ocean islands. *Global and Planetary Change*, *53*(3), 155–168. https://doi.org/10.1016/j.gloplacha.2006.04.001

Clark, G. R., & Anderson, A. (Eds.). (2009). *The Early Prehistory of Fiji* (Terra Australis Vol. 31). Australian National University ePress.

Clissold, R., McNamara, K. E., Westoby, R., Daniel, L., Raynes, E., & Obed, V. L. (2021). I thought I lost my home: resource loss, distress and recovery after the Manaro Voui volcanic disaster on Ambae Island. *Disaster Prevention and Management*, *30*(4–5), 432–446. https://doi.org/10.1108/dpm-02-2021-0027

Connell, J. (2012). Population Resettlement in the Pacific: lessons from a hazardous history? *Australian Geographer*, *43*(2), 127–142. https://doi.org/10.1080/00049182.2012.682292

Connell, J. (2016). Last days in the Carteret Islands? Climate change, livelihoods and migration on coral atolls. *Asia Pacific Viewpoint*, *57*(1), 3–15. https://doi.org/10.1111/apv.12118

Dannenberg, A. L., Frumkin, H., Hess, J. J., & Ebi, K. L. (2019). Managed retreat as a strategy for climate change adaptation in small communities: public health implications. *Climatic Change*, *153*(1–2), 1–14. https://doi.org/10.1007/s10584-019-02382-0

Davidson, J. S. (1990). The Lapita site at Natunuku, Fiji. *New Zealand Journal of Archaeology*, *12*, 121–155.

Delgado, L. G., & Sánchez, F. G. (2025). Island communities and sea level rise: Resettlement and maladaptation, the Kuna people of Isberyala, Panama. *International Journal of Disaster Risk Reduction*, *119*, 105313. https://doi.org/10.1016/j.ijdrr.2025.105313

Devi, S. (2018). Ten schools reopen post-STC Winston. *Fiji Times*. https://www.fijitimes.com.fj/ten-schools-reopen-post-stc-winston/

Di Piazza, A., & Pearthree, E. (1999). The spread of the 'Lapita people': a demographic simulation. *Journal of Artificial Societies and Social Simulation*, *2*(3), 1–8.

Di Piazza, A., & Pearthree, E. (2001). An island for gardens, an island for birds and voyaging: a settlement pattern for Kiritimati and Tabuaeran, two mystery islands in the northern Lines, Republic of Kiribati. *Journal of the Polynesian Society*, *110*(2), 149–170.

Dreyer, J. (2025). The Power of Victimhood: A Relational Analysis of the Diplomatic Negotiations on a UN Loss and Damage Fund. *Millennium-Journal of International Studies*. https://doi.org/10.1177/03058298251318780

Duijndam, S. J., Botzen, W. J. W., Hagedoorn, L. C., & Aerts, J. (2022). Anticipating sea-level rise and human migration: A review of empirical evidence and avenues for future research. *Wiley Interdisciplinary Reviews-Climate Change*, *13*(1). https://doi.org/10.1002/wcc.747. Article e00747.

Elmerhebe, T. (2016). Mt Annan man raising money for Fijian family affected by Cyclone Winston. *Daily Telegraph*. https://www.dailytelegraph.com.au/newslocal/macarthur/mt-annan-man-raising-money-for-fijian-family-affected-by-cyclone-winston/news-story/e7748121fc089e17105c28a70b60e39f

Endacott, J., & Alam, S. (2023). Mainstreaming displacement in development policies: An analysis of Solomon Islands and Vanuatu approaches. *Review of European Comparative & International Environmental Law*, *32*(1), 136–148. https://doi.org/10.1111/reel.12474

Faleolo, R. (2020). Pasifika diaspora connectivity and continuity with Pacific homelands: Material culture and spatial behaviour in Brisbane. *Australian Journal of Anthropology*, *31*(1), 66–84. https://doi.org/10.1111/taja.12348

Falkland, T., & White, I. (2020). Freshwater availability under climate change. In L. Kumar (Ed.), *Climate Change and Impacts in the Pacific* (pp. 403–448). Springer Nature.

Farbotko, C., & Lazrus, H. (2012). The first climate refugees? Contesting global narratives of climate change in Tuvalu. *Global Environmental Change-Human and Policy Dimensions*, *22*(2), 382–390. https://doi.org/10.1016/j.gloenvcha.2011.11.014

Fiji One News Team (2024). Vunitogoloa remains flooded, public urged to prioritse safety. *Fiji One News (online)*. https://fijionenews.com.fj/vunitogoloa-remains-flooded-public-urged-to-prioritise-safety/

Fitzpatrick, S. (2008). Maritime interregional interaction in Micronesia: Deciphering multi-group contacts and exchange systems through time. *Journal of Anthropological Archaeology*, *27*, 131–147. https://doi.org/10.1016/j.jaa.2007.12.002

Florez, C. (2023). *Adaptation Fund: Proposal for Fiji (Strengthening the Adaptive Capacity of Coastal Communities in Fiji to Climate Change through Nature-Based Seawalls)*.

Fraser, J. (1954). *Gold Dish and Kava Bowl*. Dent.

Frazer, R. M. (1961). *Land Use and Population in Ra Province, Fiji*. [PhD, Australian National University].

Frazer, R. M. (1968). A social and economic history of Ra Province. *Transactions and Proceedings of the Fiji Society*, *9*, 93–122.

Freeman, C., Niusulu, A. L., Schaaf, M., Taua'a, T. S., Tanielu, H., Ergler, C., & Kivalu, M. (2023). Identity, belonging and place attachment amongst Pacific Island children: a photographic analysis. *Childrens Geographies*, *21*(2), 271–286. https://doi.org/10.1080/14733285.2022.2039900

Gifford, E. W. (1951). Archaeological excavations in Fiji. *University of California Archaeological Records 18* (1), 1–148.

Gordon, A. (1897-1912). *Fiji: Records of Private and of Public Life 1875–1880* . R. and R. Clark.

Haas, S., Gianoli, A., & Van Eerd, M. (2021). The roles of community resilience and risk appraisal in climate change adaptation: the experience of the Kannagi Nagar resettlement in Chennai. *Environment and Urbanization*, *33*(2), 560–578. https://doi.org/10.1177/0956247821993391

Hogg, N. W. S., Chen, Y. L. E., Summerhayes, G. R., Boswijk, G., Manning, S. W., Hogg, A. G., & Gosden, C. (2022). Building on the past: Refining our current understanding of Lapita stilt structures. *Australian Archaeology*, *88*(3), 268–281. https://doi.org/10.1080/03122417.2022.2148184

IPCC. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability (Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change)*. Cambridge University Press. https://doi.org/10.1017/9781009325844

IPCC (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (Eds.)]*. IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647

Irwin, G., Shaw, B., & McAlister, A. (2019). The origins of the Kula Ring: Archaeological and maritime perspectives from the southern Massim and Mailu areas of Papua New Guinea. *Archaeology in Oceania*, *54*(1), 1–16. https://doi.org/10.1002/arco.5167

Jevrejeva, S., Williams, J., Vousdoukas, M., & Jackson, L. P. (2023). Future sea level rise dominates changes in worst case extreme sea levels along the global coastline by 2100. *Environmental Research Letters*, *18*(2). https://doi.org/10.1088/1748-9326/acb504

Jones, C., Murray, W. E., & Overton, J. (2017). Fiji Water, water everywhere: global brands and democratic and social injustice. *Asia Pacific Viewpoint*, *58*(1), 112–123. https://doi.org/10.1111/apv.12144

Karamperidou, C., & DiNezio, P. N. (2022). Holocene hydroclimatic variability in the tropical Pacific explained by changing ENSO diversity. *Nature Communications*, *13*(1), 7244. https://doi.org/10.1038/s41467-022-34880-8

Karasov-Olson, A., Schwartz, M. W., Skikne, S. A., Hellmann, J. J., Olden, J. D., Lawrence, D. J., Morisette, J. T., Schuurman, G. W., Allen, S., Brigham, C. A., Buttke, D., Miller-Rushing, A. J., Trammell, M., & Hoffman, C. H. (2021). Co-development of a risk assessment strategy for managed relocation. *Ecological Solutions and Evidence*, *2*(3). https://doi.org/10.1002/2688-8319.12092. Article e12092.

Kassam, K. A. S., Ruelle, M. L., Samimi, C., Trabucco, A., & Xu, J. (2018). Anticipating climatic variability: the potential of ecological calendars. *Human Ecology*, *46*(2), 249–257. https://doi.org/10.1007/s10745-018-9970-5

Kirch, P. V. (2000). *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*. University of California Press.

Knutson, T., Camargo, S. J., Chan, J. C. L., Emanuel, K., Ho, C. H., Kossin, J., Mohapatra, M., Satoh, M., Sugi, M., Walsh, K., & Wu, L. (2020). Tropical Cyclones and Climate Change Assessment: Part II: Projected Response to Anthropogenic Warming. *Bulletin of the American Meteorological Society*, *101*(3), E303–E322. https://doi.org/10.1175/BAMS-D-18-0194.1

Korovulavula, I., Nunn, P. D., Kumar, R., & Fong, T. (2020). Peripherality as key to understanding opportunities and needs for effective and sustainable climate-change adaptation: a case study from Viti Levu Island, Fiji. *Climate and Development*, *12*(10), 888–898. https://doi.org/10.1080/17565529.2019.1701972

Kuhlken, R., & Crosby, A. (1999). Agricultural terracing at Nakauvadra, Viti Levu: a Late Prehistoric irrigated agrosystem in Fiji. *Asian Perspectives*, *38*(1), 62–89.

Kumar, R., Nunn, P. D., Field, J. S., & de Biran, A. (2006). Human responses to climate change around AD 1300: A case study of the Sigatoka Valley, Viti Levu Island, Fiji. *Quaternary International*, *151*(1), 133–143. https://doi.org/10.1016/j.quaint.2006.01.018

Kumar, R., Nunn, P. D., & Nakoro, E. (2021). Identifying 3000-year old human interaction spheres in central Fiji through Lapita ceramic sand-temper analyses. *Geosciences*, *11*, 238. https://doi.org/10.3390/geosciences11060238

Lykins, A., Cosh, S., Nunn, P. D., Kumar, R., & Sundaraja, C. (2023). Io, keimami leqataka vakalevu na vei gauna mai muri (we are worried about the future generation): experiences of eco-grief in rural indigenous Fijians. *Global Environmental Psychology*, *1*, e11447.

MacDonald, M. C., Elliott, M., Langidrik, D., Chan, T., Saunders, A., Stewart-Koster, B., Taafaki, I. J., Bartram, J., & Hadwen, W. L. (2020). Mitigating drought impacts in remote island atolls with traditional water usage behaviors and modern technology. *Science of the Total Environment*, *741*, 140230. https://doi.org/10.1016/j.scitotenv.2020.140230

McAdam, J. (2014). Historical cross-border relocations in the Pacific: lessons for planned relocations in the context of climate change. *Journal of Pacific History*, *49*(3), 301–327. https://doi.org/10.1080/00223344.2014.953317

McAlister, A., & Allen, M. S. (2017). Basalt geochemistry reveals high frequency of prehistoric tool exchange in low hierarchy Marquesas Islands (Polynesia). *PloS one*, *12*(12). https://doi.org/10.1371/journal.pone.0188207. Article e0188207.

Mcleod, E., Bruton-Adams, M., Forster, J., Franco, C., Gaines, G., Gorong, B., James, R., Posing-Kulwaum, G., Tara, M., & Terk, E. (2019). Lessons From the Pacific Islands - adapting to climate change by supporting social and ecological resilience. *Frontiers in Marine Science*, *6*, 289. https://doi.org/10.3389/fmars.2019.00289

McMichael, C., Farbotko, C., Piggott-McKellar, A., Powell, T., & Kitara, M. (2021). Rising seas, immobilities, and translocality in small island states: case studies from Fiji and Tuvalu. *Population and Environment*, *43*(1), 82–107. https://doi.org/10.1007/s11111-021-00378-6

McMichael, C., & Katonivualiku, M. (2020). Thick temporalities of planned relocation in Fiji. *Geoforum*, *108*, 286–294. https://doi.org/10.1016/j.geoforum.2019.06.012

McMichael, C., Powell, T., Piggott-McKellar, A. E., & Yee, M. (2025). Climate change and the planned relocation of people: A longitudinal analysis of Vunidogoloa, Fiji. *Ambio*, *54*(6), 1043–1056. https://doi.org/10.1007/s13280-024-02120-6

McMillen, H. L., Ticktin, T., & Springer, H. K. (2017). The future is behind us: traditional ecological knowledge and resilience over time on Hawai'i Island. *Regional Environmental Change*, *17*(2), 579–592. https://doi.org/10.1007/s10113-016-1032-1

McNamara, K. E., Clissold, R., Westoby, R., Piggott-McKellar, A., Kumar, R., Clarke, T., Namoumou, F., Areki, F., Joseph, E., Warrick, O., & Nunn, P. D. (2020). An assessment of community-based adaptation initiatives in the Pacific Islands. *Nature Climate Change*, *10*, 628–639. https://doi.org/10.1038/s41558-020-0813-1

McNamara, K. E., & Des Combes, H. J. (2015). Planning for community relocations due to climate change in Fiji. *International Journal of Disaster Risk Science*, *6*(3), 315–319. https://doi.org/10.1007/s13753-015-0065-2

McNamara, K. E., Westoby, R., & Clissold, R. (2022). Lessons for adaptation pathways in the Pacific Islands. *PLOS Climate*, *1*(2), e0000011. https://doi.org/10.1371/journal.pclm.0000011

McNiven, I. J. (2015). Precarious islands: Kulkalgal reef island settlement and high mobility across 700 km of seascape, central Torres Strait and northern Great Barrier Reef. *Quaternary International*, *385*, 39–55. https://doi.org/10.1016/j.quaint.2014.09.015

Miller, F., & Dun, O. (2019). Resettlement and the environment in Vietnam: Implications for climate change adaptation planning. *Asia Pacific Viewpoint*, *60*(2), 132–147. https://doi.org/10.1111/apv.12228

Moore, L. (2024). State Responsibilities and International Obligations in Responding to Climate Mobilities: What Should International Assistance Look Like? In S. Jolly, N. Ahmad, & M. Scott (Eds.), *Climate-Related Human Mobility in Asia and the Pacific: Interdisciplinary Rights-Based Approaches* (pp. 199–219). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-3234-0_12

Muiderman, K., Vervoort, J., Gupta, A., Norbert-Munns, R. P., Veeger, M., Muzammil, M., & Driessen, P. (2023). Is anticipatory governance opening up or closing down future possibilities? Findings from diverse contexts in the Global South. *Global Environmental Change-Human and Policy Dimensions*, *81*, 102694. https://doi.org/10.1016/j.gloenvcha.2023.102694

Nerem, R. S., & Fasullo, J. (2019). Observations of the rate and acceleration of global mean sea level change. *Bulletin of the American Meteorological Society*, *100*(1), S15–S18. https://doi.org/10.1175/bams-d-18-0247.1

Newland, L. (2015). The Lost Tribes of Israel - and the Genesis of Christianity in Fiji: Missionary Notions of Fijian Origin from 1835 to Cession and Beyond. *Oceania*, *85*(3), 256–270. http://www.jstor.org/stable/44161347

Nichols, A. (2019). Climate change, natural hazards, and relocation: insights from Nabukadra and Navuniivi villages in Fiji. *Climatic Change*, *156*(1–2), 255–271. https://doi.org/10.1007/s10584-019-02531-5

Nolet, E. (2016). Are you prepared?' Representations and management of floods in Lomanikoro, Rewa (Fiji). *Disasters*, *40*(4), 720–739. https://doi.org/10.1111/disa.12175

Geographical Review, *97*(1), 1–23. https://doi.org/10.1111/j.1931-0846.2007.tb00277.x

Nunn, P. D. (2007b). *Climate, Environment and Society in the Pacific during the Last Millennium*. Elsevier.

Nunn, P. D. (2007c). Space and place in an ocean of islands: thoughts on the attitudes of the Lapita people towards islands and their colonization. *South Pacific Studies*, *27*, 24–35.

Nunn, P. D. (2009a). Geographical influences on settlement-location choices by initial colonizers: a case study of the Fiji Islands. *Geographical Research*, *47*(3), 306–319. https://doi.org/10.1111/j.1745-5871.2009.00594.x

Nunn, P. D. (2009b). *Vanished Islands and Hidden Continents of the Pacific*. University of Hawai'i.

Nunn, P. D. (2012). Societal disruption in the Pacific Islands from rapid sea-level fall about AD 1300: new evidence from northern Viti Levu Island, Fiji. *Journal of Coastal Conservation*, *16*, 199–209. https://doi.org/10.1007/s11852-010-0142-z

Nunn, P. D., & Campbell, J. R. (2020). Rediscovering the past to negotiate the future: how knowledge about settlement history on high tropical Pacific islands might facilitate future relocations. *Environmental Development*, *35*, 100546. https://doi.org/10.1016/j.envdev.2020.100546

Nunn, P. D., Ishimura, T., Dickinson, W. R., Katayama, K., Thomas, F., Kumar, R., Matararaba, S., Davidson, J., & Worthy, T. (2007). The Lapita occupation at Naitabale, Moturiki Island, central Fiji. *Asian Perspectives*, *46*(1), 96–132.

Nunn, P. D., Kohler, A., & Kumar, R. (2017). Identifying and assessing evidence for recent shoreline change attributable to uncommonly rapid sea-level rise in Pohnpei, Federated States of Micronesia, Northwest Pacific Ocean. *Journal of Coastal Conservation*, *21*(6), 719–730. https://doi.org/10.1007/s11852-017-0531-7

Nunn, P. D., & Kumar, R. (2019). Measuring peripherality as a proxy for autonomous community coping capacity: a case study from Bua Province, Fiji Islands, for improving climate change adaptation. *Social Sciences*, *8*, 225. https://doi.org/10.3390/socsci8080225

Nunn, P. D., & Kumar, R. (2024). Disaster management and climate change adaptation using traditional and local knowledge (TLK) in the Pacific Islands. *Oxford Research Encyclopedia of Natural Hazard Science* (pp. 1–24). Oxford University Press. https://doi.org/10.1093/acrefore/9780199389407.013.543

Nunn, P. D., Kumar, R., Elrick-Barr, C., Glover, M., Korovulavula, I., Kotra, K. K., Macdonald, B., Ram, A., Smith, T. F., & Thomsen, D. (2025a). Water, people and climate-change exposure in the Western Pacific: Anticipating the arrival of a 'perfect storm'. *PLOS Water*, *4*(7), e0000389. https://doi.org/10.1371/journal.pwat.0000389

Nunn, P. D., Luebbers, R., Hesp, P. A., Murray-Wallace, C. V., Wilson, C., Bourman, R. P., Roberts, A., Moffat, I., da Miot, G., Dillenburg, S. R., Tamura, T., & Reilly, M. (2025b). Calibrating Holocene human–environment interactions using ancient narratives: The example of Ngurunderi in South Australia. *Journal of Island and Coastal Archaeology*, *20*(3), 563–587. https://doi.org/10.1080/15564894.2024.2337096

Nunn, P. D., Nakoro, E., Kumar, R., Nanuku, M., & Camailakeba, M. (2022). How island peoples adapt to climate change: insights from studies of Fiji's hillforts. In M. T. Carson (Ed.), *Palaeolandscapes in Archaeology: Lessons for the Past and Future* (pp. 313–339). Routledge. https://doi.org/10.4324/9781003139553-11

Nunn, P. D., & Peltier, W. R. (2001). Far-field test of the ICE-4G model of global isostatic response to deglaciation using empirical and theoretical Holocene sea-level reconstructions for the Fiji Islands, southwestern Pacific. *Quaternary Research*, *55*(2), 203–214.

O'Connor, S., McWilliam, A., Fenner, J. N., & Brockwell, S. (2012). Examining the origin of fortifications in East Timor: social and environmental factors. *Journal of Island and Coastal Archaeology*, *7*(2), 200–218. https://doi.org/10.1080/15564894.2011.619245

Palanisamy, H., Cazenave, A., Delcroix, T., & Meyssignac, B. (2015). Spatial trend patterns in the Pacific Ocean sea level during the altimetry era: the contribution of thermocline depth change and internal climate variability. *Ocean Dynamics*, *65*(3), 341–356. https://doi.org/10.1007/s10236-014-0805-7

Parry, J. T. (1997). *The North Coast of Viti Levu, Ba to Ra. Air Photo Archaeology and Ethnohistory* (Vol. 10). The Fiji Museum. (Bulletin of the Fiji Museum)).

Paulik, R., Williams, S., Simi, T., Bosserelle, C., Ting, J. C., & Simanu, L. (2021). Evaluating building exposure and economic

loss changes after the 2009 South Pacific Tsunami. *International Journal of Disaster Risk Reduction*, *56*., Article 102131. https://doi.org/10.1016/j.ijdrr.2021.102131

Penman, B. S., Gupta, S., & Shanks, G. D. (2017). Rapid mortality transition of Pacific Islands in the 19th century. *Epidemiology and Infection*, *145*(1), 1–11. https://doi.org/10.1017/s0950268816001989

Petzold, J., Joe, E. T., Kelman, I., Magnan, A. K., Mirbach, C., Alverio, G. N., Nunn, P. D., Ratter, B. M. W., & Global Adaptation, M. (2023). Between tinkering and transformation: A contemporary appraisal of climate change adaptation research on the world's islands. *Frontiers in Climate*, *4*, 1072231. https://doi.org/10.3389/fclim.2022.1072231

Piggott-McKellar, A. E., & McMichael, C. (2021). The immobility-relocation continuum: Diverse responses to coastal change in a small island state. *Environmental Science & Policy*, *125*, 105–115. https://doi.org/10.1016/j.envsci.2021.08.019

Piggott-McKellar, A., McMichael, C., & Powell, T. (2021). Generational retreat: locally driven adaption to coastal hazard risk in two Indigenous communities in Fiji. *Regional Environmental Change*, *21*(2), 49. https://doi.org/10.1007/s10113-021-01780-4

Rayalu, T. T. K. (2025). *Written question response from Fiji Minister for Agriculture and Waterways*. https://www.parliament.gov.fj/wp-content/uploads/2025/04/Response-to-Written-Question-26-of-2025.pdf

Robb, K. F., & Nunn, P. D. (2014). Changing role of nearshore-marine foods in the subsistence economy of inland upland communities during the last millennium in the tropical Pacific Islands: Insights from the Ba River Valley, Northern Viti Levu Island, Fiji. *Environmental Archaeology*, *19*(1), 1–11. https://doi.org/10.1179/1749631413Y.0000000012

Roth, J., & Hooper, S. (Eds.). (1990). *The Fiji Journals of Baron Anatole von Hügel 1875–1877*. Fiji Museum.

Salmon, C., Duvat, V. K. E., & Laurent, V. (2019). Human- and climate-driven shoreline changes on a remote mountainous tropical Pacific Island: Tubuai, French Polynesia. *Anthropocene*, *25*, 100191. https://doi.org/10.1016/j.ancene.2019.100191

Schofield, N., & Ojha, H. (2024). State of Freshwater Resources in the Pacific. In A. Dansie, H. K. Alleway, & B. Böer (Eds.), *The Water, Energy, and Food Security Nexus in Asia and the Pacific: The Pacific* (pp. 23–49). Springer International Publishing. https://doi.org/10.1007/978-3-031-25463-5_2

Sharan, A., Lal, A., & Datta, B. (2021). A review of groundwater sustainability crisis in the Pacific Island countries: Challenges and solutions. *Journal of Hydrology*, *603*, 127165. https://doi.org/10.1016/j.jhydrol.2021.127165

Simms, J. R. Z., Waller, H. L., Brunet, C., & Jenkins, P. (2021). The long goodbye on a disappearing, ancestral island: a just retreat from Isle de Jean Charles. *Journal of Environmental Studies and Sciences*, *11*(3), 316–328. https://doi.org/10.1007/s13412-021-00682-5

Smythe, S. M. (1864). *Ten Months in the Fiji Islands*. Parker.

Souter, R. T. C., Ruuska, D., Pene, S., Benjamin, C., Funubo, S., Beal, C., Sanderson, R., Batikawai, S., Ravai, A., Antoinette-Wickham, T., Rankin, T., Peter, L., Molitambe, H., Theophile, G., Shrestha, S., Kotra, K. K., Buguro, H., Panda, N., Deo, V., & Love, M. (2024). Strengthening rural community water safety planning in Pacific Island countries: evidence and lessons from Solomon Islands, Vanuatu, and Fiji. *Journal of Water and Health*, *22*(3), 467–486. https://doi.org/10.2166/wh.2024.144

Suhardiman, D., Ariando, W., Supriadi, D. A., & Indrabudi, T. (2025). Bakelam: Sea nomads' knowledge systems and potential building block for living with change. *Political Geography*, *119*, 103335. https://doi.org/10.1016/j.polgeo.2025.103335

Tabe, T. (2019). Climate Change Migration and Displacement: Learning from Past Relocations in the Pacific. *Social Sciences-Basel*, *8*(7). https://doi.org/10.3390/socsci8070218

Terry, J. P., & Lau, A. Y. A. (2018). Magnitudes of nearshore waves generated by tropical cyclone Winston, the strongest landfalling cyclone in South Pacific records. Unprecedented or unremarkable? *Sedimentary Geology*, *364*, 276–285. https://doi.org/10.1016/j.sedgeo.2017.10.009

van der Geest, K., Burkett, M., Fitzpatrick, J., Stege, M., & Wheeler, B. (2020). Climate change, ecosystem services and migration in the Marshall Islands: are they related? *Climatic Change*, *161*(1), 109–127. https://doi.org/10.1007/s10584-019-02648-7

van de Wal, R. S. W., Nicholls, R. J., Behar, D., McInnes, K., Stammer, D., Lowe, J. A., Church, J. A., DeConto, R., Fettweis, X., Goelzer, H., Haasnoot, M., Haigh, I. D., Hinkel, J., Horton, B. P., James, T. S., Jenkins, A., LeCozannet, G., Levermann, A., Lipscomb, W. H., & White, K. (2022). A High-End Estimate of Sea Level Rise for Practitioners. *Earth'S Future*, *10*(11). https://doi.org/10.1029/2022ef002751. Article e2022EF002751.

Wallis, M. A. L. (1851). *Life in Feejee*. William Heath.

Walsh, K. J. E., Camargo, S. J., Knutson, T. R., Kossin, J., Lee, T. C., Murakami, H., & Patricola, C. (2019). Tropical cyclones and climate change. *Tropical Cyclone Research and Review*, *8*(4), 240–250. https://doi.org/10.6057/2019tcrr04.04

Weisler, M. I. (1996). Taking the mystery out of the Polynesian mystery islands: a case study from Mangareva and the Pitcairn Group. In J. M. Davidson, G. Irwin, B. F. Leach, A. Pawley, & D. Brown (Eds.), *Oceanic Culture History: Essays in Honour of Roger Green* (pp. 615–629). New Zealand Journal of Archaeology Special Publication.

Williams, T. (1858). *Fiji and the Fijians* (Vol. I). The Islands and their Inhabitants). Alexander Heylin.

Williams, T., & Calvert, J. (1859). *Fiji and the Fijians*. Appleton.