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Perspectives on climate change and adaptation in Fijian villages contemplating relocation

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Planned relocation is increasingly recognized as a necessary response to escalating climate risks, yet little is known about how such decisions unfold at the community level. Drawing on dialogs and field visits at seven iTaukei (Indigenous Fijian) villages across Fiji, this report examines how communities are experiencing and responding to climate-related challenges. Findings reveal cascading impacts—including flooding, land loss, disrupted livelihoods, and psychological stress—that have prompted a range of adaptation strategies, from *in-situ* adjustments to full or partial relocation, with mixed outcomes. Despite growing pressures, most communities expressed a strong, culturally grounded preference to remain in place. Challenges in reaching consensus and securing funding reflect the complexity of relocation processes. Moreover, traditional governance structures do not always ensure equal participation, highlighting the importance of attending to intra-community dynamics. To minimize loss and damage while ensuring agency and resilience of frontline communities, climate mobility frameworks will need to support anticipatory planning, uphold community agency, and recognize immobility as a legitimate and often preferred option.

KEYWORDS

planned relocation, loss and damage, immobility, SIDS, climate change impacts, managed retreat, governance, maladaptation

1 Introduction

The Asia-Pacific region is the most disaster-prone region in the world (ESCAP, 2023; UNDRR, 2019). Economic loss due to disasters (1.6% of GDP) is more than double the rate of any other region (United Nations Office for Disaster Risk Reduction, 2022). Hazard-related mortalities are also disproportionately high with over half in the region resulting from storms and floods (ADB, 2013; ESCAP, 2023). Furthermore, climate change scenarios project continued sea level rise and fewer but more intense cyclones in the region (CSIRO, 2014). Extreme weather events have already been displacing considerable numbers of people across the globe (WMO, 2024). Many consider migration from low-lying coastal zones and Small Island Developing States (SIDS) unavoidable; relocations relating to climate change impacts are already taking place, even within the 1.5 Celsius threshold (Vousdoukas et al., 2023; Robinson, 2020).

Meanwhile, many of the most vulnerable communities have demonstrated overwhelming preference to remain where they are. For these communities, considerations relating to cultural identity, values, and place attachment outweigh recurring and exacerbating climate impacts (Jamero et al., 2017; Mortreux and Barnett, 2009; Crichton

et al., 2020; Farbotko, 2023). For policy makers and external donors, there is a pressing need to better understand these communities in order to ensure their immediate and long-term safety and wellbeing. However, while low- and middle-income countries face the most severe risks of climate change, most adaptation studies have focused on high-income country contexts (Kuruppu and Willie, 2015).

We report on the circumstances of Fijian villages that relocated, are considering, or are resisting the prospect of relocating due to climate change-related impacts. Fiji has had the highest number of injuries and mortality from natural disasters in the Pacific region (excluding New Zealand and Australia) (CRED/UCLouvain, 2025). Like many other Pacific Island countries, the country is endowed with a rich, diverse ecosystem and cohesive communities with intimate ties to the natural environment (UNDRR, 2019). Many of its communities sit along a river or coast and face existential threats including impacts on its subsistence agriculture, coastal and marine resources, freshwater, land, and due to cyclone exposure (World Bank, 2021; UNDRR, 2019; Sevudredre, 2023). While there are community relocations in other Pacific countries, Fiji is a forerunner in preparing and implementing policies to guide community relocations (UNDRR, 2023; Lund, 2021).

2 Method

We report on fieldwork conducted in March 2024 to gain an overview of community relocation as climate change adaptation in Fiji across seven *iTaukei* (Indigenous Fijian) communities at various stages of relocation on Vanua Levu (Nabavatu, Vunivau, Nacekoro, Vunidogoloa) and Viti Levu (Nawaqarua, Matawalu, Dratabu) of Fiji [Table 1; Supplementary material 1 (map) and Supplementary material 2 (village-by-village summary)]. The selection of villages sought geographical and procedural representation, as well as logistic feasibility. Government officials in charge of disaster response and cultural preservation ensured the relevance of these villages for our survey. Field visits were officially approved by the Fijian government

(see 2.1) and organized by a paid local assistant with governmental and academic experience pertaining to relocation.

Field visits entailed interviews and *talanoa*, a traditional dialog session where those involved can openly share their perspectives (Yee et al., 2022b). Every visit started with a traditional opening ceremony in the village hall or representative's home. The researchers then briefed the village representative(s) about the team and the purpose of the visit (to gain insights in the contexts and motivations driving community relocation decisions). An *iTaukei* author provided translations as needed. The subsequent conversation was loosely structured around the perceived impacts of climate change, adaptation strategies, and circumstances of, or views on, relocation. We also asked about the village profile, such as population data and the composition of villagers' livelihoods. Our primary informants were village leaders such as the headman, a community-appointed government liaison who typically serve as acting leader to ensure wellness of the village. Where other community members were present, we interviewed them after initial interactions with the village leaders. After the interviews, we toured the village infrastructure with a key informant who pointed out hazards (e.g., an eroding riverbank), roads, community hall, church, homes and sources of livelihoods, and relevant impacts from past or ongoing disasters.

Dialogs with relevant government authorities and governmental and nongovernmental organizations provided further context to our field visits (Supplementary material 3). Dialogs were held as part of courtesy visits before visiting villages within the respective geographic region, with one exception of a jurisdictional commissioner that requested an additional report back after the field visits. The diverse stakeholders allowed us to cross-validate individual statements of relevance on various community challenges and adaptation efforts.

Researchers took handwritten field notes during the fieldwork. Two researchers digitized these field notes as word documents for cross-validation across researchers. Village-by-village summaries were then written up. As climate impacts and adaptation strategies were seen to be similar across villages, these were summarized in mind map format (i.e., Figures 1, 2).

TABLE 1 Village profiles.

Community, province	Population	Main livelihood sources	Proximity to urban center
Nawaqarua, Ba	64 households 338 residents	Employment, fishing	Vadradra / Ba: ~10km
Matawalu, Ba	135 households 655 residents	Employment (government, hotels), fishing, farming	Lautoka: ~10km
Vunivau, Macuata	7 households	Farming, fishing, employment	Labasa: ~5km (across river)
Nacekoro, Cakaudrove	22 households 105 residents	Employment (hotels), farming, fishing	Savusavu: ~5km
Nabavatu, Macuata	124 households 473 residents	Employment, farming, fishing,	Labasa: 65km
Vunidogoloa, Cakaudrove	32 households 160 residents	Fishing, farming, handcrafts, remittances	Daily bus to Savusavu (40km)/ Labasa (65km)
Dratabu, Ba	224 households 1325 residents	Employment (hotels, government), farming, fishing	Nadi: ~5km

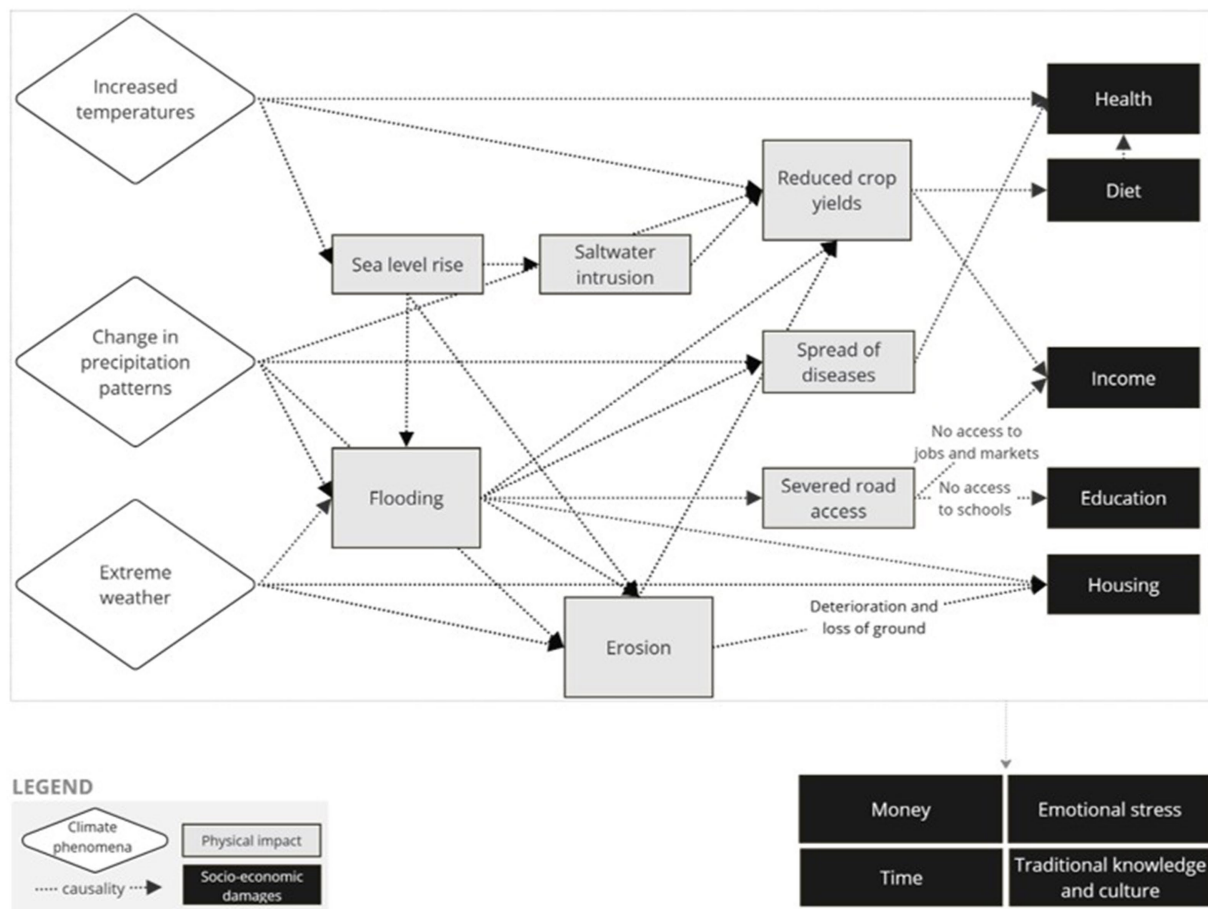


FIGURE 1
Multi-level impacts of climate change.

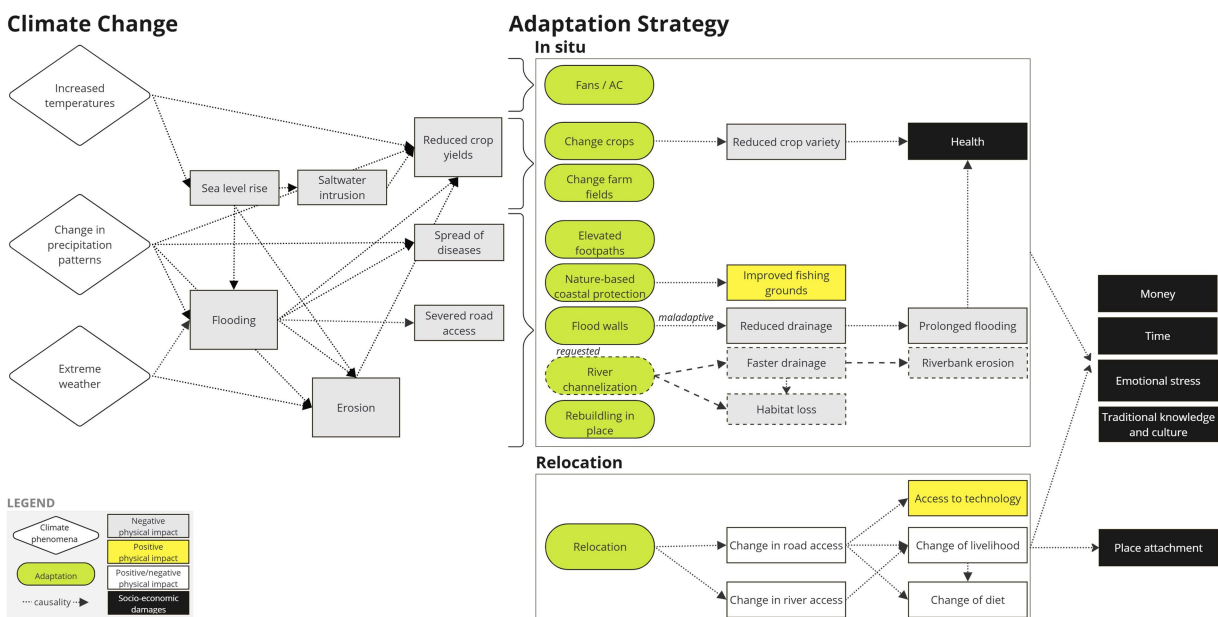


FIGURE 2
Adaptation strategies and their impacts.

2.1 Ethics statement

Our visits were approved by the Ministry of iTaukei Affairs (Reference #MTA-42/2-10), relevant division commissioners, provincial councils, and each village chief. A provincial officer and iTaukei representative accompanied all field visits and ensured cultural protocols were upheld.

3 Results

Table 2 provides an overview of village-by-village context and circumstances pertaining to relocation, detailed in [Supplementary material 2](#). All villages that we visited were or had been located along a coast or river. Two villages (Vunidogoloa and Dratabu) had relocated, and representatives conveyed general satisfaction with the fact that they had successfully evaded the hazard that necessitated the relocation. Three villages (Matawalu, Nawaqarua, and Nacekoro) had no community consensus regarding relocation, with older villagers uninterested in moving. Two villages were awaiting government support for relocation (Vunivau and Nabavatu).

3.1 Common impacts of climate change

Direct impacts of flooding, cyclones and coastal erosion, e.g., damage to housing and physical assets, diminished land area, were widely reported. Similarly prevalent were indirect impacts of flooding such as severed access to farmland, schools, jobs, and markets. Access to markets, wage labor, and schools was obstructed by flooding or high river water levels for Vunivau, Nacekoro, and Dratabu before relocation. Diseases (e.g., acute gastroenteritis due to contaminated water and disrupted sanitation) were also reported.

Across the board, villages discussed how climate change impacted access to and/or availability of farm and fishing grounds and cash income from produce and catch sales. Changes in temperature and rainfall patterns were impacting crop yields. Vunidogoloa suffered from saltwater intrusion before relocating. Matawalu had limited farmland due to riverine erosion. Flooding of farming grounds drove Vunivau villagers to clear and cultivate mountainous terrain. Compromises in fishery resources were attributed to cyclone disturbance in Nabavatu. However, pollution was seen as a bigger issue in Nawaqarua, Matawalu, Nacekoro and Dratabu.

Figure 1 summarizes the main impacts of climate change discussed in the villages. It is a visual aid created by the author team as an overview of how village informants conveyed the climate change impacts. It did not aim to be exhaustive of, e.g., all causal relationships among the topics discussed. Even so, the complex chain of impacts demonstrates the diverse range and nature of climate change impacts. Some, such as heat stress (i.e., health impacts of increased temperatures) are relatively direct, while others, such as opportunity costs of losing access to urban centers (e.g., reduced income and education due to severed road access because of flooding) are a few degrees removed from changes in the climate. Emotional stress was explicitly alluded to as fear during rain due to traumatic past disaster experiences. However, the entire impact chain clearly induced stress and anxiety (also reported in [Clissold et al., 2022](#); [Ralogaivau, 2024](#)), alongside monetary, human, and cultural costs ([Adger et al., 2013](#)),

and we have depicted it as such. The figure does not capture how impacts cascade among one another (e.g., reduced income negatively impacting diet or education), nor contextual challenges such as development (e.g., pollution) and governance institutions that were not central in the community discussions.

3.2 In-situ adaptation

Figure 2 summarizes ways in which villagers were responding, or were considering responding, to climate change impacts. Strategies range from installing fans to ameliorate high temperatures and early warning systems to mitigate risks, rebuilding lost or damaged housing further and further back from the coast as gradual, repeated retreat ([Robins et al., 2024](#)), and relocation of the village itself. These adaptation strategies also have impacts, some of which may not have been foreseen (also reported by, e.g., [Piggott-McKellar et al., 2019](#)). For example, walls (seawall, river wall, floodwall) were the most desired adaptation method with communities visited (Matawalu, Nacekoro, Nawaqarua). Yet, where they were in place, walls were insufficient (Matawalu) or had unintended secondary consequences such as blocking drainage and prolonging floods (Vunivau, and Vunidogoloa before relocation). Villages repeatedly “shifting” houses away from eroding river banks include Matawalu, Nawaqarua, and Nacekoro. Other means of onsite adaptation included footpaths, i.e., paved paths inside villages that were otherwise unpaved and would muddy under wet conditions (Dratabu and Matawalu; planned in Nawaqarua), and alarms for rising river water (Nawaqarua). Nacekoro witnessed the protective benefit of mangroves against extreme weather and is one of multiple villages (Matawalu, planned in Nawaqarua) planting mangroves and vetiver grass along its coast.

3.3 Relocation

Many of the communities reported frequent and considerable damage due to environmental changes. They anticipated further, and more serious damages in the future. Some village leaders considered relocation after significant damage, such as those of cyclones (e.g., Nacekoro, Nabavatu, Vunivau), and the understanding and observation of their increasing frequency and magnitude. However, such communal struggles were insufficient grounds for community consensus on relocation. Although he ultimately succeeded, Vunidogoloa's former leader struggled to persuade all households to move. The majority of Nabavatu's households have lived in temporary tent shelters since a combined climatic and seismic disaster, but the chief remained put since some households decided to remain in place. Leaders of Nacekoro and Nawaqarua wish to relocate but have not gained the community's consensus, largely meeting resistance from senior members who do not wish to leave their birthplace. In the case of Matawalu, the leadership is more senior and not interested in relocating, although some able village members have started building houses uphill on their own accord. Stronger resistance to moving among senior citizens was a common pattern across the villages visited, and one that informants indicated to be a critical component of intra-village dynamics of decision making regarding relocation. Dratabu, a larger village which relocated in the 1950's, relocated based on the consensus of the leadership council but

TABLE 2 Overview of community traits and relocation process according to key informants.

Community	Relocation status	Main reasons for relocation	Notable characteristics or challenges	<i>In-situ</i> adaptation	Relevant documentation
Nawaqarua	Not initiated.	Flooding and erosion.	No consensus on relocation. Educated youth leadership. Pollution due to upstream sand mining.	Early warning system, drainage. Village has shifted 5 times in 15 years. Planned: riverwall and mangrove planting.	Neef et al. (2020) and Neef et al. (2018)
Matawalu	Community requested second seawall; government declined and encouraged relocation.	Flooding and erosion. Lack of farmland.	No consensus on relocation. Population increase on limited land. Pollution due to development.	Mangroves, footpaths, “shifting houses continuously”	Daurewa (2019)
Vunivau	Applied in 2021 for government support to relocate housing across the river.	Flooding, cutting off road access. Loss of subsistence farming during flooding season. Fear of rain.	Intends to commute to <i>in-situ</i> farmland.	Downstream river gates and seawall (outdated capacity). Cultivation uphill. Village desires river realignment.	Architects Without Frontiers (2024)
Nacekoro	Awaiting government support to relocate uphill for safety from flooding. Oral promise by previous prime minister in 2016.	Housing loss & damage from 2016 cyclone; flooding cuts off road access. Erosion due to illegal sand extraction.	No community consensus on relocation. Some land disowned without current generation's knowing. Pollution from upstream.	Planting mangroves and vetiver grass for coastal protection. Many villagers want a seawall.	UNESCO (2017) and Mataiciwa (2021)
Nabavatu	Undergoing partial relocation; third year in tent shelters since 2021 overnight evacuation	Unsafe terrain due to excessive rain and earthquake (cracks, landslides, seepages).	First implementation of Fiji Relocation Guidelines. Time lag due to formal government processes. No river fish or ship access since cyclone.	Village desires river dredging	Government of Fiji (2023) and Sevudredre (2023)
Vunidogoloa	Full relocation in 2014	Flooding, erosion, saltwater intrusion, exposure to cyclones	Considered first and successful case of climate change induced relocation. Commute to former site for fishing is challenging for older villagers.	Seawall (failed)	Bertana (2020), Bertana and Blanton (2022), Borsa (2020), Bower et al. (2023), Charan et al. (2017), McMichael and Powell (2021), McNamara and Jacot Des Combes (2015), Piggott-McKellar et al. (2019), Piggott-McKellar et al. (2019), White (2019), Sevudredre (2023), Ralogaivau (2024), Government of Fiji (2023), Edwards (2012), The Republic of Fiji (2018), Tronquet (2015), McMichael and Katonivaliku (2020), McMichael et al. (2019), USP (2024), and Reucassel et al. (2023)
Dratabu	Partial relocation in 1956 in response to health advisory related to flooding.	Flood-related diseases (lptos, typhoid, ringworms)	Longstanding chief. Some villagers reside on the pre-relocation site. Shelters neighboring villages during emergencies.	Post-relocation: Evacuation center, footpaths (own and government funding)	Bose and Fraenkel (2007) and Parke (2014)

without persuading individual households, some of which remain in the former village location. This approach contrasts with others (Vunidogoloa, Nawaqarua) that prioritized staying together as a village.

Relocation entails major livelihood changes. In the case of Vunidogoloa, Kenani (their new location) had improved road access but was distant from fishing grounds, rendering them more dependent on monetary transactions (as documented by McMichael and Powell,

2021). While villagers continue to commute to their original fishing grounds, the steep commute was challenging and time-consuming for middle to older aged fishers. The proposed destination for Nacekoro is far from the coast and road, though fertile for farming, suggesting that relocation would pose a challenge for their present primary livelihoods of fishing and hotel work.

3.4 Government

Most village leaders perceived challenges in gaining government support. In some cases, government recommendations of relocation had not been accepted by the community, which preferred support for *in-situ* adaptation such as river or seawalls (Matawalu, Nawaqarua). Moreover, government recommendations do not necessarily entail assistance. Dratabu self-funded their relocation in the 1950's, prompted by a Ministry of Health advisory. In recent years, the government has endeavored to facilitate and channel funding for relocation. Vunidogoloa's relocation was supported by the government; Nabavatu's relocation is in limbo due complications in the government processes, and others are in line for assistance to relocate (Vunivau, Nacekoro). Nabavatu's leadership acknowledged that villagers were capable of constructing housing, and that they may have taken things into their own hands had they known at the onset that they would be "waiting" for government assistance in tents for 3 years. Government representatives clarified that they had not intentionally withheld available information from Nabavatu; they were also in the dark, as this was their first time implementing the federal relocation process.

4 Discussion

4.1 Climate change and governance in iTaukei villages

These preliminary findings do not indicate clear tendencies or conclusive evidence regarding village decision making around relocation. The seven villages are varied in the basic attributes we surveyed such as village size, location, and occupational structure, with no clear linkages to their positions regarding relocation. However, all were iTaukei villages with many commonalities in the climate change impacts, adaptation strategies, and governance mechanisms. That all villages were located along the coast was no coincidence; the British colonial government mandated all villages to relocate to a river or coast in 1874 (Sevudredre, 2023). While there are also inland cases of relocation [e.g., Tukuraki due to rainfall-induced landslide and subsequent cyclone (Platform on Disaster Displacement, 2022)], it is reasonable to expect continued prevalence of coastal issues in Fiji.

Moreover, iTaukei villages have common organizational structures, decision making processes, and cultural values. According to this structure, village decisions are made by the core clan(s). While we only observed one instance where villagers expressed dissatisfaction about having been left out of this decision making, this may have been the case for other villages as well. Sevudredre (2023) reports a similar situation for Vunidogoloa, whereby only members of the core clan was involved in the decision making. This does not necessarily conflict with the account we heard, i.e., that all *households* consented to the

relocation, and presumably follows the iTaukei organizational structure. Unequal social terrain within communities and households is not unique to the iTaukei or Fiji, but suspected or observed in broader reviews of relocation (Zickgraf, 2021).

Fiji's *Standard Operating Procedures for Planned Relocation* (Office of the Prime Minister, 2023) is explicit about inclusive, participatory, consensus-based approaches. It admits individuals *and* communities the right to voluntary immobility. If individuals or communities decide not to relocate, the State is to respond to by providing risk information and protection in their current state. It may seem that these Procedures give individuals (esp. minorities within communities, such as those that joined the village through marriage) more right to self-determination than they have according to iTaukei tradition. At the same time, while minority members expressed dissatisfaction about not being considered in the decision making, it is not clear whether they were forced to follow the community decision. The Vunidogoloa villager quoted by Sevudredre (2023) indicated that she and her peers "went along." In Dratabu, some families decided not to go along with the village leaders' decision to relocate. However, these families remain part of the village collective and network of mutual help (Yoshida et al., 2025). In other words, iTaukei cultural protocols around assisting individuals who choose not to relocate may, in practice, be comparable to the national Procedures.

An additional commonality among the villages was that the key spokesperson, who in most cases was the village headman, played a key role in facilitating the decision making. The headman is a village-appointed government position, and not a traditional, clan-bound iTaukei position; the village chief is the ultimate authority. In most villages, it appeared that the headman played a more active role in persuading the community – incl. senior members who tended to be most reluctant to move – to relocate. Chiefs appeared to be less approachable due to their high status.

4.2 Voluntary immobility and long-term viability of *in-situ* strategies

Most village representatives expressed strong preferences to remain in their original location, together. This strong preference is widely reported within and outside the Pacific (Jamero et al., 2017; Mortreux and Barnett, 2009; Robins et al., 2024; Yee et al., 2022b; McMichael et al., 2021; Farbotko, 2023; Wiegel et al., 2021). It also manifested in expenses incurred as communities strived to maintain their village in place. Place (i.e., *vanua*, which encompasses the ecological, social, and spiritual community) is an essential aspect of iTaukei ethos (Gelves-Gómez and Brincat, 2021). At a more superficial level, relocation is apt to bring about considerable lifestyle changes, for both better and worse (McMichael and Powell, 2021; Yee et al., 2024; Caron, 2023). It is understandable and previously reported that communities would not relocate without exhausting all options to remain in place (Yee et al., 2022a; Robins et al., 2024).

Nonetheless, known resource constraints necessitate that long-term viability of adaptation strategies be considered (A. Piggott-McKellar, 2020; UNEP, 2023). Negative impacts of existing flood walls, for example, suggest they were installed without sufficient foresight, expert deliberation or customization to the local context (A. E. Piggott-McKellar et al., 2020). Such realities call for careful consultation and consideration of alternative strategies to address issues at hand before

installing river walls, channelizing streams, or river dredging as currently requested by other villages.

4.3 Current and past relocation cases

Contrasts across actual cases of community relocation – Nabavatu, Vunidogoloa and Dratabu – illustrate diverse trajectories of reactive and proactive relocation. Nabavatu's was an unplanned, overnight relocation, resulting in enduring struggles in temporary shelters. Vunidogoloa is widely considered a planned and successful case of community relocation, but lack of coordination and or power asymmetries with the government, as well as dissatisfaction with the decision-making procedures are also reported (Bertana, 2020; Sevudredre, 2023). According to government officials, Vunidogoloa being the first case of government-assisted relocation meant the process was ad-hoc and thus somewhat flexible. Nabavatu's ongoing relocation has been administratively complicated as the first implementation of Fiji's relocation guidelines.

Dratabu's case beckons contemplation for having organized and executed its own partial relocation in the 1950's [elucidated in our follow-up study (Yoshida et al., 2025)]. Our informant's account of the process centered on coordinating consensus among its tribes (i.e., gaining approval of land-owning clans). Physical labor was undertaken by members of Dratabu and surrounding villages. Building materials were acquired through traditional social networks, without monetary transactions. Circumstances have changed since. Houses have modernized; the natural resources necessary for building traditional houses have been largely depleted; people and land are less available due to development. However, houses are still being built with village labor, guided by a hired professional. Social networks and principles of mutual help (*solesolevaki*) remain strong in Fiji (Yila et al., 2013; Neef et al., 2020). Further, Dratabu's leader described thinking and acting for 10–20 years in the future. He had initiated administrative processes for expanding the village in anticipation of further population growth. Although he also found government support to be slow and unreliable, this seemed not to have obstructed the construction of communal infrastructure, some of which were funded by sales of the village's natural resources (rocks). The relative prosperity of the village hinted that the village had benefited from its foresightful past governance.

4.4 Limitations

We report on limited understanding of a handful of communities. Our understanding is based on inputs from a few representatives of each community. Most communities had received (in some cases, many) government and academic visitors, and previous dialogs may have guided their narrative. Also, while we briefed each community about our role as researchers (i.e., that we were not in a position to bring in development projects), such initial expectations were palpable at times. These circumstances could have led our informants to elucidate on more dramatic aspects of their experiences. Moreover, all official community representatives were male. When a female researcher talked separately with female community members, she learned of dissatisfaction with the exclusivity of the decision-making

process, documented elsewhere (Bertana, 2020; Sevudredre, 2023) but that had not come up in discussions with village leaders.

4.5 Future directions

The findings underscore the importance of viewing climate change impacts as complex, cascading chains that intersect with cultural and developmental contexts. Community-level studies must ensure that research reflects the voices and experiences of all community members – not only of dominant groups. Further, while quantifying and validating these impact chains may support efforts to attribute specific losses and damage to climate change, their inherent complexity suggests this may be an impossible task. Rather, funding mechanisms (e.g., GCF, 2025) may need to be adjusted to ensure accessibility to areas with the greatest needs.

In terms of local adaptation strategies, communities had intimate knowledge of the challenges at hand but not full knowledge of possible options and their broad and long-term impacts. Transfers of relevant knowledge from comparable regions may be helpful to diversify viable strategies. Transdisciplinary science, bringing together key stakeholders (Harris et al., 2024), may also help to facilitate consensus and to ensure effective and efficient allocation of resources. Empirical reports from longitudinal monitoring of adaptation strategies and past cases of relocation would also offer critical insights in this decision making process.

Ultimately, our findings suggest that most communities are unlikely to relocate in anticipation of intolerable climate change impacts. Yet if relocation remains a necessary measure for low-lying coastal areas—and adaptation resources continue to fall short—we risk failing to meet global commitments to a just and safe future. Vulnerable communities should not be forced to endure avoidable suffering or be subjected to adaptation measures they do not want. Governments and donors must be careful not to delegitimize immobility as a valid and often preferred response (Robins et al., 2024; Farbotko et al., 2020). Anticipatory adaptation will require both the removal of structural constraints and community engagement in ways that respect and further their agency.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

Ethical approval was not required for the studies involving humans because this report is based on scoping activities conducted to involve potential participants in the development of a formal research project. Activities posed minimal risk to participants and did not require a full ethics review according to guidelines of the Institutional Review Board of the National Institute for Environmental Studies. The studies were conducted in accordance with the local legislation and institutional

requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements because our activities posed minimal risk to participants. All participants were informed of the purpose of our visit, orally consented to engaging in dialog, and did so voluntarily.

Author contributions

YY: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. GS: Investigation, Writing – review & editing, Conceptualization, Methodology, Visualization. GM: Investigation, Project administration, Validation, Writing – review & editing. RC: Investigation, Project administration, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fclim.2025.1579299/full#supplementary-material>

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