



# “To care and improve little by little, that’s how we can do it”: Exploring Indigenous perspectives on environmental health and community solutions through participatory workshops in Amantaní, Peru

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## ABSTRACT

This study explores the conceptualisation of environmental health, environmental concerns, and ideas for change within the Amantaní community, an Indigenous Quechua-speaking population in the Peruvian Andes. Through participatory, group-based, and creative activities, community members engaged in reflective discussions about their environment, drawing upon their rich cultural heritage and intimate connection with the land. Thematic analysis of workshop discussions revealed three key themes: (1) Nature, health, and heritage: the interconnectedness of Indigenous wellbeing; (2) Environmental concerns: threats to Indigenous lands and livelihoods; and (3) Community mobilisation and solutions: Indigenous responses to environmental challenges. The findings underscore the importance of culturally informed approaches to environmental conservation, emphasising the need for inclusive governance that respects Indigenous autonomy. The study highlights the value of Traditional Ecological Knowledge (TEK) in fostering resilience, the pressing challenges posed by tourism, and the emotional toll of environmental degradation. Mental health co-benefits should be integrated into climate strategies in Indigenous communities and fostering community agency through inclusive partnerships is crucial for long-term sustainable development and resilience.

## 1. Introduction

### 1.1. Conceptualising environmental health

Environmental health refers to the intricate relationships between environmental factors and human health, addressing both physical risks (e.g., toxins, pollution, and climate change) and broader socioecological determinants (Myers and Patz, 2009; Prüss-Ustün et al., 2006). While Western biomedical frameworks tend to focus on measurable exposures and health outcomes, often prioritising physical health concerns, Indigenous worldviews offer a more holistic conception. These perspectives emphasise the interconnectedness of physical, cultural, spiritual, and mental health dimensions, reflecting the deep interconnections between land, community, and wellbeing, and recognising that the health of the environment and people are deeply intertwined (Acosta and Abarca, 2018; Sangha et al., 2015; Tu’itahi et al., 2021). For the Quechua community of Amantaní island, the land is integral to their

identity and cultural heritage, and environmental degradation not only threatens physical health but also undermines their sense of belonging, spiritual practice, and emotional wellbeing.

This study explores the environmental health experiences of Amantaní, where local environmental challenges intersect with broader global environmental issues. Through participatory, group-based activities, we seek to document how Amantanians understand and respond to environmental health threats. Importantly, this research works *with* the community rather than *on* them, reflecting a commitment to co-created knowledge that respects Indigenous perspectives (Escobar, 2011a; Freire, 2005; Shiu-Thornton, 2003; Wilson, 2019). By centring Traditional Ecological Knowledge (TEK) (Seltenrich, 2018) and community-driven solutions, this study aims to elevate local expertise in addressing the pressing environmental challenges that affect the wellbeing of Amantaní’s residents.

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## 1.2. Interconnected environmental concerns: biodiversity loss, climate change, and pollution

Indigenous communities worldwide are facing interrelated environmental crises, such as biodiversity loss, climate change, and pollution, with these challenges disproportionately impacting them due to their close relationship with the land (Álvarez and Coolsaet, 2020; Davis and Ramírez-Andreotta, 2021; Lastra Landa and Bueno, 2022). In Latin America, the Quechua people, including those on Amantani Island, have historically engaged in sustainable land management practices that maintain biodiversity. However, these practices are increasingly threatened by both natural and human-made forces (Garnett et al., 2018; Mistry and Berardi, 2016).

The impacts of climate change are particularly pronounced in the Peruvian Andes, where communities like Amantani face challenges such as glacier retreat, water scarcity, and agricultural stress (USAID, 2023). Pollution, stemming from extractive industries and inadequate waste management, compounds the problem, directly threatening both the environment and human health (Gascón, 2022). Environmental contaminants, such as heavy metals, are known to have detrimental effects on physical health, including neurological damage and stunted growth (Anticona and San Sebastian, 2014).

The interplay of these environmental concerns creates a particularly complex and pressing situation for Indigenous communities like Amantani, where environmental threats are not just physical but also cultural and emotional. The emotional toll of environmental degradation, such as solastalgia (eco-anxiety), underscores the importance of addressing the broader psychological and cultural dimensions of environmental health (Dillarstone et al., 2023; Pihkala, 2020).

## 1.3. Environmental health as a wicked and super wicked problem

The environmental challenges faced by Indigenous communities, like the Quechua peoples of Amantani, epitomise the concept of *wicked problems*—complex, interconnected issues that are resistant to simple solutions (Crowley and Head, 2017). Wicked problems are characterised by uncertainty, the involvement of diverse stakeholders, and the need for ongoing problem-solving (Rittel and Webber, 1973). Climate change, pollution, and biodiversity loss, when considered together, create a web of environmental challenges that cannot be disentangled into singular issues. Each of these challenges intersects with social, cultural, and political factors, exacerbating the complexity of the situation.

Furthermore, the environmental crises in Indigenous communities, including on Amantani, align with the concept of *super wicked problems*—problems that not only share the characteristics of wicked problems but also include additional layers of complexity, such as the lack of a central authority to address the issues and the fact that the people most affected by the issues are often the least empowered to resolve them (Levin et al., 2012). Super wicked problems also tend to be marked by urgency, where delay in action further compounds the negative impacts, creating a self-reinforcing cycle of degradation (Sipos et al., 2025). In the case of Amantani, these challenges are compounded by the added pressure of external forces, such as tourism, extractive industries, and global climate change policies that often fail to consider local Indigenous perspectives and needs (Gascón, 2022; Kronik and Verner, 2009).

## 1.4. Decolonial and participatory approaches to environmental health

To effectively address the super wicked problems of environmental health in Indigenous contexts, participatory and decolonial methodologies are essential. These approaches prioritise working *with* Indigenous communities, rather than conducting research *on* them, and seek to centre local expertise and lived experiences in environmental health discourse (Chew and Chief, 2023; Davis and Ramírez-Andreotta, 2021). By fostering inclusivity and collaboration, these methodologies enable diverse perspectives to shape a more comprehensive understanding of

environmental challenges and solutions.

Participatory methods are especially crucial in Indigenous environmental health as they allow Indigenous peoples to define their own priorities, concerns, and strategies for addressing environmental issues (Chew and Chief, 2023; Davis and Ramírez-Andreotta, 2021). These methods dismantle the power hierarchies inherent in traditional research approaches, ensuring that communities have ownership over both the research process and the solutions that emerge from it. Decolonial methodologies further challenge Western-centric environmental justice frameworks by promoting inclusive and equitable approaches that respect Indigenous governance structures and knowledge systems (Álvarez and Coolsaet, 2020; Igwe et al., 2022; Kronik and Verner, 2009).

A key element of this participatory approach is the recognition and incorporation of Traditional Ecological Knowledge (TEK), which embodies the accumulated wisdom, practices, and beliefs of Indigenous communities developed through long-standing, direct relationships with the natural environment (Seltenrich, 2018). TEK offers a holistic view of the interconnectedness of ecosystems and human health, integrating not only ecological knowledge but also spiritual and cultural dimensions of sustainability (Finn et al., 2017). Our study values TEK as an essential tool for addressing the complexities of environmental health, as it provides alternative, locally grounded frameworks for managing and responding to environmental challenges (Sipos et al., 2025).

While much of the literature on TEK has focused on contexts in the United States and Canada, there is a growing need for research that explores TEK in Latin American Indigenous communities (Álvarez and Coolsaet, 2020). This study responds to that need by highlighting the valuable knowledge systems of the Amantani community, acknowledging their expertise in environmental stewardship, and centring their lived experiences as the foundation for co-creating sustainable solutions to environmental challenges (Kronik and Verner, 2009).

## 1.5. Approach and aim

This study aims to investigate how the Amantani community conceptualises environmental health and responds to the interrelated environmental challenges of climate change, pollution, and biodiversity loss. Through participatory and decolonial research methods, we aim to document the community's Traditional Ecological Knowledge (TEK) and explore how it can inform community-driven solutions. By working *with* the community, we seek to amplify their voices and integrate their perspectives into broader environmental health discourse. This approach challenges dominant, top-down environmental health frameworks, offering a more inclusive, culturally relevant pathway to sustainable development. Situated within the broader context of the EVE project (Mannell et al., 2021), this study also aims to contribute to academic and practical strategies for improving environmental health in Indigenous contexts.

## 2. Methods

### 2.1. Study setting

Peru's diverse geography—coast (*Costa*), highlands (*Sierra*), and jungle (*Selva*)—presents unique environmental challenges (Brown et al., 2023). Amantani, an island in Lake Titicaca, sits at 12,507 feet above sea level, and is revered in Inca cosmology as the birthplace of their empire (Cheong, 2008). Home to approximately 4000 Quechua-speaking residents, many identify as direct descendants of the Inca, blending Quechua and Aymara customs with Spanish (Cheong, 2008). Tourism and agriculture form the economic backbone, with communal land ownership ensuring local control (Cheong, 2008; Gascón and Mamani, 2022). Despite benefits, community-based tourism strains resources and exacerbates environmental and social inequities (Gascón, 2022). The relative isolation of the Island preserves traditions but challenges

healthcare and infrastructure (Calderon et al., 2023; Calderón et al., 2019). The historical relationship between Indigenous peoples and the Peruvian state is characterised by a legacy of colonial racism and disenfranchisement, which continues to influence the socioeconomic and cultural dynamics of Indigenous communities today (Cheong, 2008). Understanding the environmental health concerns of Amantaní requires a comprehensive approach that incorporates Indigenous knowledge and practices. The community's deep connection to the land and their holistic worldview are crucial for developing effective and culturally appropriate environmental health interventions.

## 2.2. Study design

We used qualitative, participatory, group-based and creative methods to allow an in-depth exploration of environmental health issues as witnessed and interpreted by community-based researchers (CBRs). These methods aimed to help break down power dynamics and make the research process less extractive (Scammell, 2010; Zaragocin and Caretta, 2021). The participatory design empowered CBRs to engage in shared decision-making, ensuring their voices were central to the research process (Cornish et al., 2023; Wilson, 2019). The use of engaging arts-based activities further supported CBRs in discussing environmental challenges and solutions based on their culturally-informed understandings of the connections between people, plants, animals, land, and water (Coemans and Hannes, 2017).

Aligned with the principles of community-engaged participatory environmental health research, these methods are particularly suited to exploring complex environmental issues because they are collaborative, locally-led, and inclusive. The approach resisted imposing a Western perspective, instead prioritising Indigenous ways of knowing and seeing the world. These activities encouraged participants to engage with the research process on their own terms, fostering a more equal power dynamic between researchers and participants (Chew and Chief, 2023; Lykes et al., 2021).

## 2.3. Sample and recruitment strategy

The CBRs were recruited as part of the broader EVE project described above using snowballing techniques and one-to-one conversations with community members and local leaders. Recruitment aimed for a male and female representative from each of Amantaní's 10 districts. Whilst 20 CBRs were initially recruited, one man and three women dropped out and one man was unavailable, resulting in seven women and eight men taking part in the activities focused on environmental health and climate change relevant for this study.

## 2.4. Data collection

This study uses data from two workshops. The first focused explicitly on climate change and the environment in May 2023. The second was a 2-day project evaluation workshop that took place in November 2023. These workshops were led by Puno-based facilitators with backgrounds in social science, anthropology and public management who have worked closely with the CBRs over the last few years and are well-experienced in delivering participatory workshops that align with Indigenous community values. Both workshops were gender-segregated and led by same-gender facilitators to address concerns around power dynamics undermining women's perspectives in mixed groups. This approach sought to respect community preferences for safe, inclusive spaces that were conducive to sharing.

Facilitators conducted activities in Spanish because previous attempts to use a Quechua translator were not well received by the CBRs, who preferred Spanish over the dialect used. This approach also respected their preference to use Quechua among themselves during breaks and informal discussions, while using Spanish for formal engagement during the activities.

The activities were iterative and accumulative, allowing in-depth exploration of ideas through dynamic, participatory methods. These included collaborative collage, drawings, maps, nature walks, and storytelling, all of which encouraged participants to share their lived experiences, insights, and cultural knowledge. These activities were designed to promote critical reflection, group dialogue, and collective decision-making, central tenets of participatory and decolonial research methodologies (Cornish et al., 2023; Lykes et al., 2021). Topics such as the meaning of environmental health and climate change in the Amantaní communities, the interconnection between nature and well-being, the significance of Lake Titicaca, and potential community-driven solutions to local environmental problems were explored. More detailed descriptions of these activities are provided in Appendix A Tables A.1 and A.2.

The analysis that follows primarily focuses on these focus group discussions (FGDs) as data, complemented by images of group work pieces to contextualise ideas, thus allowing the research to remain grounded in local Indigenous experiences and knowledge systems.

## 2.5. Data analysis

After both workshops, facilitators shared initial reflections with the broader team. The Peruvian team then transcribed and translated the workshop data into reports which were then read by the UK team, and the lead author (LJB) analysed the data therein using thematic network analysis.

Working with the English translations, LJB used a mix of deductive and inductive coding, assigning codes based on questions in the facilitators guide and allowing codes related to new topics to emerge. Themes were developed using the three stages of thematic network analysis (Attride-Stirling, 2001) including: (1) coding data into basic themes; (2) aggregating basic themes into organising themes based on patterns; and (3) summarising organising themes into global or overarching themes. A consensus meeting was held with the second author (HB) who conducted an independent thematic analysis, and discussion revealed very similar interpretations. The final set of themes was then agreed with the rest of the authorship team at the manuscript review stage. We present the overarching themes and organising themes as our findings below.

## 2.6. Positionality

The authors are a mix of university-educated UK and Peru-based researchers who have worked collaboratively with the local people in Amantaní since 2021. Although we have a well-established relationship based on trust and co-production, we acknowledge the subjectivity that occurs in the research and writing process, and the need for reflexivity regarding how knowledge is situated and shared (Darwin Holmes, 2020; Moulton and Carey, 2023). We have used direct quotes to centre Amantanian perspectives and share ideas from their point of view but acknowledge that the constraints of the English language biased publication system means that some nuance may be lost and that we are still perpetuating colonial research practices to some extent. After all co-authors, including the Peruvian workshop facilitators, approved the manuscript draft, we shared a Spanish summary of the key findings with the participants to allow them to review, validate, and confirm the accuracy of the stories and perspectives represented.

## 2.7. Ethics

Ethical clearance was granted as part of the broader EVE project from University College London, UK (ref: 9663/002) and Comité Institucional de Bioética de Via Libre, Peru (ref: 6315). Participants were invited to take part in the research voluntarily, gave their written informed consent to participate and be recorded, and for their creative works and photographs to be shared as part of the research process. Each group created their own workshop ground rules which further ensured locally-

relevant ethical participation. All participant names are pseudonymised.

### 3. Results

Participants, aged 20–52, had diverse marital statuses and occupations, with women primarily housewives and men engaged in farming, fishing, music, and tourism. The following section presents three main themes, highlighting the interconnectedness of environmental health, cultural heritage, and community resilience, summarised in Fig. 1.

#### 3.1. Theme 1 - Nature, health, and heritage: he interconnectedness of Indigenous wellbeing

##### 3.1.1. Intricate knowledge of the island's features: cultural identity and pride tied into connection with nature and place

Participants highlighted significant cultural landmarks, reflecting their spiritual connection to nature:

*“On the positive side, there are things we see and celebrate that are very important to the island of Amantaní, such as the Pachamama [Mother Earth] temple. [...] In this place, we find it important to perform ceremonies [...] January 20th is the day we make this offering, and it's very important [...] for our wellbeing, that there's rain and blessings on our crops.” (Luisa)*

Other landmarks with important mythological and cultural significance include the fountain of youth in *Occosuyo*, and *Occotunes*, a nearby small island. These places are peaceful spots for prayer, meditation, and relaxation, enhancing wellbeing:

*“I go up to watch the sunset on Pachamama mountain, I also meditate and breathe fresh air. Up there, the air is very pure, it's not polluted, it's very good for the lungs [...] I feel good up there” (Luisa)*

This knowledge translated into a deep connection to the land. Luisa described how people ask, *“Why do you get used to living there?”* and she responds, *“Thank God, I live here, it's like paradise.”* One of the workshop activities was a nature walk in the local area, during which participants were encouraged to observe animals, insects, plants, trees and flowers. Afterwards, the groups reconvened in a FGD to reflect on the

interconnection between nature and wellbeing. Guillermo shared that he felt *“lucky, privileged”* and Horacio felt *“happy, proud, and fortunate to live here.”* Dario expressed pride in the surroundings, *“The first thing you feel when you see the mountain range is the excitement of living at the highest altitude, the highest in the world. And speaking of visitors, it's impressive for them. I say I live on this island, and it fills me with pride.”*

##### 3.1.2. Use of natural resources for daily activities

Locally-grown foods such as *“corn, potatoes, and oca”* (Maria) are essential to the Amantanian diet: *“This food is natural, we eat everything in a natural way”* (Valentina). Both men and women highlighted the central role of water *“for plants, for animals, for washing, for everything”* (Luisa). Heidy emphasised, *“We live with water, we can't live without it.”*

Amantaní houses are commonly equipped with kitchens that take smoke outside through chimneys. Local firewood is preferred for cooking over gas due to its *“richer flavour”* and perceived environmental benefits: it *“retains heat for an hour”* and doesn't *“harm the environment; the smoke is very natural”* (Luisa).

Stones are also vital, with stone carving and grinding being ancestral practices. Ignacio mentioned *“resources for stone carving”*, and Valentina described grinding plants *“with a batán”*, a traditional stone grinder. Walter expressed pride in sharing this cultural identity with tourists: *“we work on it [...] to grind quinoa, and I feel happy [...] It's also good to show visitors, because they want to know, and in that aspect, I also feel happy”* (Fig. 2).

##### 3.1.3. The importance of connecting with nature: Amantanian health and wellbeing depends on plants and animals

Amantanians have deep connections with natural resources. Heidy noted *“the trees, the plants, are part of health and the environment”* while Maria added that human wellbeing *“depends on plants, trees, and everything green that provides us with oxygen.”* Luisa enjoyed the nature walk because she loves *“being surrounded by vegetation, trees, and all kinds of greenery.”*

Trees were valued for providing clean air and protection. The men

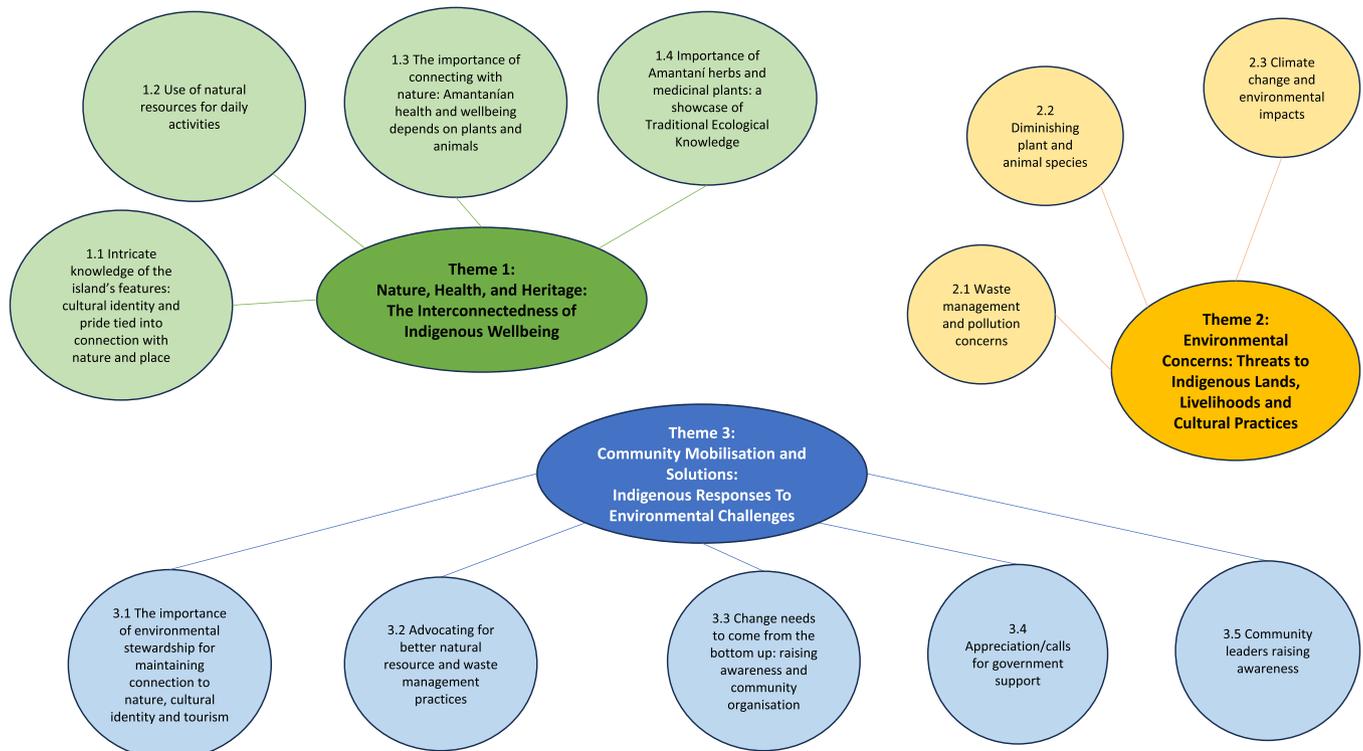


Fig. 1. Thematic map showing the three main themes and related sub-themes.



**Fig. 2.** Stone carved ashtray (one of Walter's chosen sharing circle objects). Photo by Renan Espezua, used with permission.

noted that trees “protect from the wind,” and Luisa explained that “trees protect us from frost. Without clean air or enough oxygen, there would be no life.”

Plants play a crucial role in the ecosystem. Valentina said, “I love plants, I can't live without them,” and Walter shared that “flowers give us life emotionally and psychologically.” Guillermo added, “they are good for environmental health, especially for the bees [...] Amantaní has many



**Fig. 3.** Amantaní flowers picked by Guillermo for the sharing circle. Photo by Renan Espezua, used with permission.

flowers” (Fig. 3).

The nature walks allowed participants to appreciate animals of all sizes, as Valentina shared after observing insects, “They are living beings, just like us. I really like animals [...] But we shouldn't mistreat animals because we are like a family here.”

Participants enjoyed connecting with nature, with the men feeling “clearer, more peaceful” after the walk, a sentiment shared with the women's group, with Valentina reflecting “everything was calm and beautiful, and [...] I felt truly happy.”

#### 3.1.4. Importance of Amantaní herbs and medicinal plants: a showcase of Traditional Ecological Knowledge

Herbs and medicinal plants are central to Amantanian life and knowledge. CBRs expressed pride in their rich local flora. Maria noted, “how fortunate we are to have so many medicinal plants.” The men's group explained that “almost all the plants in Amantaní have medicinal properties” (Ignacio) and “are very important for our health” (Dario, Miguel). Women emphasised reliance on natural medicines over pharmaceuticals: “here in Amantaní, we only use natural medicines” (Luisa) and “there are no pharmacies” (Heidy, Fig. 4).

Participants detailed at least 26 different medicinal plants, including chilca (*Baccharis latifolia*) for back pain, eucalipto (*eucalyptus*) for dealing with colds, matico (*Piper aduncum*) for fever, and ruda (*Ruta graveolens*) for menstrual pain (Table A.3 in Appendix A). This illustrates the depth of TEK in Amantaní.

Theme 1 underscores the deep connection between Amantanian wellbeing and their environment, highlighting the role of cultural practices and natural resources. Participants' strong ties to nature and their TEK are evident, although concerns about environmental changes and the loss of important plants were also expressed.



**Fig. 4.** Heidy sharing her expertise on local medicinal plants. Photo by Laura J Brown, used with permission.

### 3.2. Theme 2 - Environmental Concerns: threats to Indigenous lands, livelihoods and cultural practices

#### 3.2.1. Waste management and pollution concerns

Participants highlighted significant issues with waste management and pollution. Plastic waste is widespread, with burning plastics and dumping chemicals in the lake leading to environmental and health concerns. The presence of rubbish, particularly plastic, was noted “*all around the island*” (Ignacio), with Horacio recalling “*in my childhood, I didn't see plastics*” but “*now, plastic it's everywhere.*”

Participants recognised that waste is not solely from the island but also carried by wind and waves. They expressed frustration over the persistence of plastic bottles, with Dario noting “*even if we bury them in the ground, they remain the same after twenty years and never disappear.*” Despite a desire to improve waste management, there was uncertainty about effective recycling methods, leading to practices like burning rubbish which exacerbates pollution.

The rise in tourism has increased plastic waste, with Dario observing that tourists often leave plastic bottles behind. The influx of boats and motorcycles has further contributed to pollution, with Luisa and Milagros noting that even though these modern modes of travel are important because “*they transport food and carry tourists*”, they are also “*damaging the roads and polluting.*”

Participants also reported that pollution is impacting local water systems, affecting availability for both wildlife and human consumption. Walter explained that “*the water is already contaminated; even small fish are dying due to the pollution*”, and Horacio voiced concern over deteriorating water quality, “*It's becoming increasingly impossible to consume this water.*”

#### 3.2.2. Diminishing plant and animal species

Participants highlighted serious concerns about biodiversity loss, driven by pollution, climate change, and habitat degradation.

Many participants noted the decrease in plant species crucial for traditional practices and medicine. Ignacio observed, “*My grandfather used to raise cows, and [...] cut grass. There used to be plenty of grass [...]*” but now plants like “*sullina that used to grow a lot on the edges [...]* are disappearing.” The loss of some plants also threatens traditional cultural practices, such as weaving with cactus thorns. As Griselda highlighted, local “*medicinal plants [also] don't exist much anymore*” and are disappearing “*due to a lack of water.*” Miguel pointed out: “*...When there are no such plants, how will we treat our illnesses?*” The decline in these plants is tied to both pollution and water scarcity. Ignacio noted, “*algae used to be green, but now, they've turned orange due to pollution.*”

Pollution has also negatively impacted traditional food sources. Carolina remarked, “*I remember eating [llashka] when I was five or six years old, but nowadays [...] there's a lot of rubbish. That's why we don't*



**Fig. 5.** “Llashka” on the rocks eaten less now due to rubbish in the water. Photo by Carolina, used with permission.

consume it anymore [...]” (Fig. 5). Similarly, Walter highlighted changes in agriculture: “*We used to use natural fertilisers and not chemical ones*” and pointed out that plants now have worms due to pollution. This has led to a shift from natural foods to processed options, but as Walter explained, this has also had ramifications for other traditional cultural practices, because “*those plants were used before for carnivals, decorating houses, and for flower arrangements, but having worms on them as it happens now was not common.*”

Biodiversity loss extends to animals. Carolina noted that “*the mauri no longer exists. It's a [fish] species that has almost been completely wiped out, just like the carachi.*” Valentina reported a decrease in frogs and lizards. Water contamination is a significant factor here; Walter said, “*The river used to flow beautifully*” but now it's contaminated, affecting wildlife.

The reduction in plant and animal species is affecting local livelihoods. Luisa highlighted the struggle with livestock: “*Animals are dying due to lack of grass and water [...]* those who live off livestock are suffering a lot.” This scarcity has led to higher prices for dairy products and eggs.

#### 3.2.3. Climate change and environmental impacts

Climate change was a recurring topic, with participants noting its adverse effects on weather patterns, agriculture, natural resources, traditional practices, and wellbeing.

Participants observed increasingly unpredictable and extreme weather. Horacio noted, “*in my childhood, I didn't feel the wind that we feel now [...]* The waves rise all of a sudden, and they last for a week.” Ignacio added, “*this year, there has been no rain due to climate change.*”

Rough waves have made traditional boat travel difficult. Dario explained, “*my father and my grandfather used [...] small reed boats [...]* but nowadays, it's not possible to travel like that.”

Droughts are increasingly affecting crops. Dario explained, “*the climate was different in the '90s [...]* Rain used to be moderate and pleasant, but now it's a bit erratic [...] There used to be enough produce, but today we're facing a drought.”

The impact of extreme weather on crops has economic repercussions. Valentina mentioned, “*Food prices are rising. The cost of chicken has gone up, and vegetables that we used to buy for one sol are now more expensive.*”

Climate change is also harming animals. Carolina noted, the strong sun causes sheep “*to develop lumps on their necks, and they die due to the heat.*” This intense sun also affects the use of traditional clothing: “*Our 'chucu' [traditional black hat] no longer shields us from the sun,*” Heidi explained.

Increased water scarcity is linked to biodiversity loss. Luisa observed, “*the water level has dropped significantly [...]* The lack of rain has affected the algae, fish, and all plants, including herbs. That's why we don't have as many animals around anymore.”

Heidi noted, “*When everything is dry, there's no desire to look at nature; it makes us very sad.*” Dario added, “*[seeing crops affected by frost causes us] sadness, because we feel as if the plants were like us.*”

Participants acknowledged human responsibility for climate change. Maria emphasised reducing burning and deforestation to protect the ozone layer: “*Reduce the burning and cutting down of trees to not harm the ozone layer. I believe that's why the glaciers are melting.*” Participants also recognised the broader impact, with pollution and “*emissions from large factories*” resulting in “*drought as well as floods from intense rains*”, putting animals “*at risk of extinction.*”

Theme 2 captures participant observations of poor waste management practices, biodiversity loss, and climate change. They lamented the impacts on their health, traditional cultural practices, and spiritual wellbeing, emphasising a holistic approach to environmental health that honours and preserves these cultural elements. This theme underscores the urgent need for action to protect Indigenous communities and their environments.

### 3.3. Theme 3 - Community mobilisation and solutions: Indigenous responses to environmental challenges

Both groups proposed solutions for community challenges and presented them to imagined audiences. Box 1 and Fig. 6 displays the women's and men's presentations on climate change, respectively. Participants also shared ideas for community solutions throughout various other workshop activities.

#### 3.3.1. The importance of environmental stewardship for maintaining connection to nature, cultural identity, and tourism

Participants expressed regret over poor environmental practices, with Dario noting that *"Nowadays, it seems that humans only contribute to pollution, meaning that there is no practice to take care of our environment."* There was a sense of local responsibility, with comments like *"if we continue like this, we would be the ones ending everything"* from Horacio reflecting a desire for change.

Some participants attributed local environmental issues to community apathy, while others emphasised personal accountability: *"We should start the change within ourselves..."* (Luisa); *"It's within us, within ourselves, to be conscious and to do our part"* (Guillermo). This environmental stewardship is linked to the interconnected view of the local ecosystem and human wellbeing from Theme 1. Guillermo noted, *"we benefit from where we live [...] Animals are becoming extinct, and we have to figure out what to do, how to recover..."*

Keeping the island clean for tourists was a significant motivation. Ignacio said, *"If we didn't care for it, there would be no tourism, nothing, because it would be messy."* This sentiment was also pronounced in the sharing solutions activity presentations (Fig. 6). Carolina emphasised that protecting the environment is vital for preserving both tourism and Amantanian cultural identity: *"If there were no tourism, where would we be? [...] Some of us would migrate [...] our culture would be lost..."*

Environmental stewardship is seen as a collective responsibility. Valentina highlighted, *"Environmental health is very important for the community and for everyone in the world"* and Walter said, *"it's good to clean up, especially cleaning our room, our whole room, not just our room, but all of Amantaní."* During the men's group nature walk FGD, Ignacio expressed concern about pollution: *"Nobody owns the lake; we should feel proud and protect our nature,"* and Dario emphasised personal responsibility: *"we always look for someone to blame. [...] We tell ourselves, 'Who is responsible for cleaning?' When I could clean it perfectly well. I think we need to be more conscious"*.

#### 3.3.2. Advocating for better natural resource and waste management practices

Participants expressed a strong desire for improved environmental stewardship and community effort. Some suggested planting more trees,

but most solutions focused on reducing pollution and improving waste management, echoing concerns from Theme 2. Guillermo stressed, *"Above all, what we have to do is stop polluting,"* and Griselda suggested fines for littering and that people *"should take their trash with them."*

Recycling was seen as a crucial step to address climate change and pollution: *"If we were to raise awareness about recycling, I don't think these changes would occur"* (Horacio, Fig. 7). The women's group echoed this sentiment, advocating for recycling, reducing, and reusing to *"improve the air and water quality of the world."* Milagros suggested using plastic bottles as pencil holders.

However, as highlighted in Theme 2, the lack of recycling support on the island posed a challenge. The men's group proposed raising awareness about recycling, finding collection centres, and acquiring *"a boat for transporting recycled garbage to the city."* Dario emphasised the need for sustainable waste management services: *"we can propose [...] sorting plastics and all those things for the future because we still don't have these practices on the island. So, the only thing would be to recognise the importance of how to maintain it."*

#### 3.3.3. Change needs to come from the bottom up: raising awareness and community organisation

Participants saw the younger generation as key agents of change. Carolina emphasised the importance of raising youth awareness *"because they're the new generation and they [...] should step up to clean."*

Changing old, environmentally damaging behaviours was seen as essential: *"we must teach our children to try not to be like the older people since they have macho thoughts about pollution, [we must teach them] not to burn, not to cut down trees"* (Maria). Leading by example was crucial: *"The children must learn to take care of the environment. If we throw away trash, the children will see and they will never learn"* (Valentina). Inter-generational knowledge transfer in the opposite direction was also highlighted: *"In school, they teach my daughter. Sometimes, I throw trash, and my daughter tells me, 'No, mum, don't throw it there, you make the plants sad'"* (Milagros). The younger generation brought hope and inspiration with their growing environmental awareness and creative thinking.

Organising the community was seen as essential: *"We should organise the entire island; each community must commit. If we don't do it, who will?"* (Griselda). Clean-up efforts and caring for damaged areas were recurrent ideas and Amantaní's existing social structures could aid in this organisation, though broader community engagement with environmental issues varies. Luisa shared that *"Sometimes in the square on Sundays, the mayor gathers us [...] informs everyone present about what they can do [...] e.g.] some general cleaning work along the way"*.

Caring for their environment was seen as achievable with small, incremental changes: *"To care and improve little by little, that's how we can do it"* (Luisa). Organising for environmental wellbeing was also

#### Box 1

Women's group presentation on community solutions for climate change and the environment.

**Luisa:** *"For climate change, well, if we don't change now, it will always be worse. Climate change involves a time of climatic temperature variation with extensive rainfall, extreme weather events, heatwaves, and intense rainfall."*

**Milagros:** *"And heatwaves are due to global warming, that's climate change, isn't it?"*

**Luisa:** *"Those things like burning trash happen. But now, if we change, it would mean not teaching to take care of nature, but teaching to value life. Also, nature can survive without us. We can't survive without nature. We can't live without air, flowers, wind. All that would be bad. We wouldn't be, we couldn't live."*

[...]

**Milagros:** *"People, the community, hand in hand, can realise and plant more plants, reduce waste. It's a liver, take care of it."*

[...]

**Milagros:** *"Don't throw garbage into the lake."*

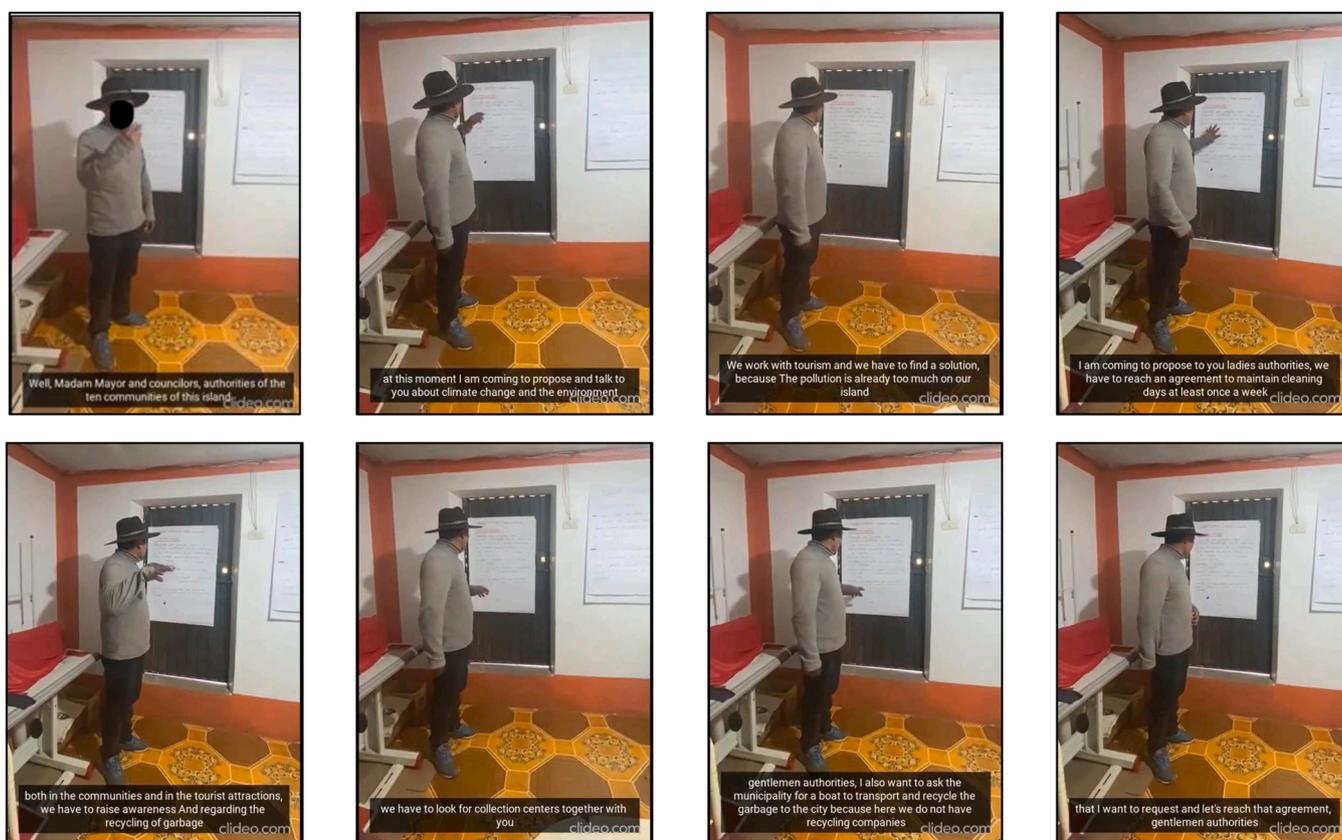


Fig. 6. Men's group sharing solutions on how to tackle climate change and environmental problems (read from left to right, top row first). Photos by Renan Espezuza, used with permission.

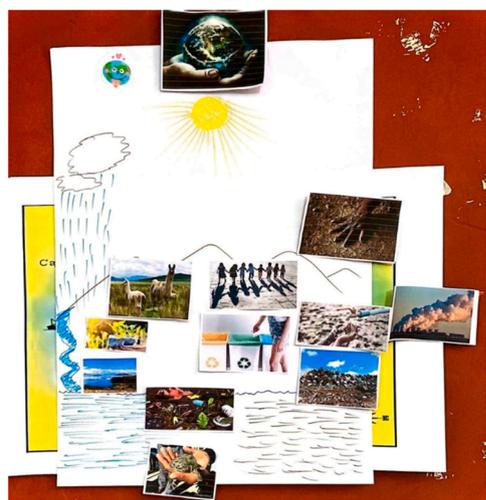


Fig. 7. Men's group climate change story highlighting a central focus on recycling. Photo by Renan Espezuza, used with permission.

recognised as beneficial for tourism: "it would be good for our wellbeing and for the tourists if we organise ourselves" (Griselda).

Working with other actors was deemed important. Participants discussed collaborating with authorities in Puno to stop boatmen from dumping trash and ensuring cleaner and safer operations: "We could go to Puno to speak with the harbour authority to ensure that the boatmen don't dump trash. If we organise ourselves, we could achieve it" (Luisa). "New boats might be necessary because we've heard that the boats can capsize. So, having a larger boat designed to handle big waves might be the solution" (Dario).

Even though collaboration with other actors was necessary, participants understood that changes needed to start within their own community: "We, the people, need to make this request for enhanced safety" (Walter).

#### 3.3.4. Appreciation/calls for government support

The discussions on boat pollution and safety underscore the need for external support, but question whether the regional government, the municipality of Puno, will provide the necessary aid. However, participants highlighted the important role of the municipality in keeping the environment clean. Valentina said, "We could come to an agreement with the community, and the municipality could organise everything to rescue our island", with Heidi adding "We can't do it alone; it's always with the community and the municipality that we need to organise and keep it clean". Participants also called for the involvement of the mayor and local leaders.

In the sharing solutions activity, participants showed their intent to engage local authorities, with the men addressing their presentation to "Madam Mayor, council members, and authorities from the ten communities of this island" (Fig. 6). This activity revealed a desire to raise awareness and hold meetings with key stakeholders. Participating in our study may have inspired CBRs to take responsibility for community engagement, as Guillermo noted: "Another [concrete step to protect the environment] would be to recycle and establish order to reduce pollution, which is what is really affecting nature. Based on that, each person can hold a small meeting or approach the authorities."

Despite the perceived importance of working with local government, some participants felt unheard by national ministries. Dario explained, "Regarding pollution, [...] if we talk about the ministry that is far from our district, it's a bit difficult because we've never been heard... we've never been listened to." Horacio added: "Pollution can be solved [locally] because we live on an island and it's not a big city, so I believe that with the authorities

and community leaders, we can solve the issue of pollution.”

In contrast, there were some positive views on national government initiatives like FONCODES (*Fondo de Cooperación para el Desarrollo Social*: National Fund for Social Compensation and Development):

*“I think we’ve all seen that FONCODES has been supporting all the communities. So, they have provided a lot of help because [...] we have also planted carrots, lettuces, and that, with some greenhouses. There has also been breeding of guinea pigs, chickens, all that. Now they are also encouraging us to put trash bins with their respective names, solid waste, and everything.”* (Carolina)

Yet, such national government initiatives often had limited success, as Milagros explained: *“We were given carrot seeds from FONCODES but what we planted also got frostbitten.”* This indicates a need for better alignment between national programs and local needs.

### 3.3.5. Community leaders raising awareness

Strong local leadership is crucial to address local needs and priorities. Griselda highlighted the need for a guiding figure, saying, *“we also need someone to guide us, maybe a mayor who organises us.”* Whilst she felt unheard in the community, Luisa expressed her own aspirations for leadership: *“That’s why, one day, I’d like to be mayor. Here, nobody cares.”*

Encouragingly, some CBRs have leadership aspirations, and Dario, who holds a local leadership position, plans to use his improved environmental health knowledge effectively:

**Dario:** *“Well, regarding this project, it’s a very important initiative for me, especially to focus on or help us understand things that we were forgetting, like environmental conservation and tourism. It has also been very important for me, especially in teaching my family at home. Now that I am an authority figure, it’s even more important for me.”*

**Facilitator:** *“Yes, precisely now you are a lieutenant, which is the highest position in your community. For example, do you share with your community the information we gather in the workshops?”*

**Dario:** *“Yes, well, I provide information or participate together with the community members, impart knowledge, or give them an explanation, and it’s a very important aspect of this project because there are no projects, or the communities are forgotten by the state, private or public institutions to talk about very important issues and the environment that is consolidated, is very important in the community, and now that I am an authority in the community, I am a little more prepared to be able to focus on them.”*

Theme 3 emphasised the need for community-driven solutions to environmental challenges. This includes organising clean-up efforts, advocating for better waste management practices, and raising awareness, especially among children and youth. Participants also called for government support and enforcement of regulations to address environmental issues effectively. CBRs in leadership roles reflected on how they could share their learning and ideas with community members, underlining the importance of strong local leadership in fostering environmental stewardship.

## 4. Discussion

This study explores the transformative potential of centring community knowledge, particularly Traditional Ecological Knowledge, in addressing environmental health challenges and promoting sustainable development on Amantaní Island. By engaging with community members, this research aimed to empower local voices, emphasising self-determination and supportive governance structures.

For the Indigenous community of Amantaní, the environment is not merely a backdrop but a fundamental aspect of cultural identity, health, and wellbeing. Participants highlighted their deep connection to the island’s natural and spiritual resources, integral to daily life and traditional practices. Integrating TEK into environmental management strategies is crucial for sustaining traditional practices and safeguarding community health and resilience (Finn et al., 2017; Ford et al., 2020; Menzies and Butler, 2006; Seltenrich, 2018). Importantly, this connection extends beyond material benefits; the mental and emotional

wellbeing of Amantaní residents is deeply tied to their relationship with the land, reinforcing the growing recognition that biodiversity conservation supports not only ecological health but also psychological health (Flores et al., 2024; Lebel et al., 2022).

### 4.1. The connection between mental health and the environment

Our participants highlighted a deep, multifaceted relationship between their wellbeing and the environment, with nature being integral to both their cultural identity and health. Participants described a profound spiritual connection to the island, including practices such as *Pachamama* ceremonies and offerings that seek blessings for the land, crops, and wellbeing. As one participant, Luisa, described, engaging in these practices and connecting to their land is closely tied to her sense of personal wellbeing, noting that she *“feels good”* in the environment. This sentiment is echoed throughout the data, where participants express pride in their land and culture, and speak about feeling privileged and lucky to live on the island. These expressions tie directly into the participants’ mental and emotional health, highlighting the central role of nature in fostering a sense of fulfilment and pride (3.1.1). This aligns with broader research on how strong place attachment and cultural identity contribute to positive mental health outcomes in Indigenous communities (Frumkin, 2001; Seltenrich, 2018).

Beyond cultural practices, the intrinsic value of nature in promoting mental health was emphasised throughout the findings. In 3.1.3, participants discussed how their health and wellbeing are intimately tied to plants and animals. The psychological benefits of interacting with nature, including feelings of peace and emotional stability, were frequently mentioned. Additionally, participants expressed a deep sense of gratitude for the island’s medicinal plants, recognising them not only for their physical healing properties but also for their role in maintaining emotional resilience. These insights highlight the importance of TEK in sustaining not just physical health but also psychological wellbeing. Learning from Indigenous communities who have long recognised the intimate connection between humans, plants, and animals, can provide valuable insights into fostering biophilic relationships that enhance mental health and environmental stewardship (Frumkin, 2001; Seltenrich, 2018).

### 4.2. Environmental degradation and psychological distress

In contrast to these positive associations, the environmental challenges described in Theme 2 reveal the emotional and psychological toll of ecological decline. In 3.2.2, participants described distress over the diminishing plant and animal species, with many expressing grief over the suffering of animals due to dwindling food and water sources. This emotional burden was particularly evident in discussions of climate change (3.2.3), where participants associated drought and ecosystem loss with sadness and spiritual pain. The lamentation of these losses illustrates how environmental change is not only a physical crisis but also an emotional and existential one, aligning with the concept of *solastalgia*—psychological distress caused by environmental degradation (Dillarstone et al., 2023; Pihkala, 2020; Rothschild and Haase, 2023). These findings reinforce the need to integrate mental health considerations into climate change mitigation and environmental management (Flores et al., 2024). Recognising the psychological dimensions of ecological loss can lead to more comprehensive policy responses that address both environmental and mental health needs.

### 4.3. Community-led responses and future directions

Despite the challenges posed by environmental degradation, Amantaní residents remain committed to fostering resilience through collective action. Participants described efforts to raise awareness within their families and communities, demonstrating a strong sense of responsibility for environmental stewardship. Previous research on

Amantaní has documented school-based awareness campaigns that educate both students and parents about the environmental health risks associated with plastic waste (Gascón, 2022). These initiatives align with Indigenous environmental justice frameworks that emphasise intergenerational knowledge-sharing as a pathway for sustainable change (Parsons et al., 2021).

The workshops facilitated in this study further strengthened these efforts, providing a platform for the community to co-develop strategies for adaptation and environmental management. The concept of "*poco a poco*"— small, incremental changes as adaptive responses to social and environmental change (Moulton and Carey, 2023) – emerged as a guiding principle for local solutions. Participants emphasised the need to integrate TEK with modern conservation practices, advocating for approaches that respect traditional lifeways while addressing contemporary environmental challenges (Kronik and Verner, 2009).

However, structural barriers remain. Environmental health risks, including waste management issues, pollution, and biodiversity loss, persist due to external pressures such as tourism and national climate policies that do not fully consider Amantaní's unique concerns (The World Bank Group, 2022). Participants expressed frustration over their limited ability to influence broader environmental decisions, highlighting a common challenge faced by Indigenous communities worldwide (Davis and Ramírez-Andreotta, 2021). Addressing these issues requires not only community-led initiatives but also stronger collaborations with government agencies and external stakeholders to ensure policies are inclusive and equitable.

#### 4.4. Policy implications and the role of Indigenous knowledge

The integration of Indigenous perspectives into climate adaptation policies is a critical next step. While initiatives like Peru's Indigenous Climate Platform and National Adaptation Plan (NAP) represent significant progress (International Institute for Sustainable Development, 2021), there is a need to ensure these frameworks meaningfully incorporate community-driven priorities to ensure *all* Indigenous voices are heard.

Community-led environmental initiatives also raise important ethical considerations regarding the distribution of responsibilities and burdens (Sharp, 2003). As highlighted in our findings, ensuring sustainable outcomes requires partnerships that balance local agency with external support. National programs such as FONCODES can play a crucial role in financing conservation efforts, but it is essential that these interventions respect Indigenous governance structures and traditional lifeways (Chew and Chief, 2023). Addressing structural challenges such as zoning, economic policies and environmental policy enforcement will be necessary to achieve long-term environmental and cultural sustainability (Davis and Ramírez-Andreotta, 2021).

Tourism further complicates these dynamics. In line with other studies, our findings show that while tourism contributes to cultural pride and socioeconomic development, it also exacerbates plastic waste and environmental degradation (Cheong, 2008; Gascón, 2022). Sustainable Indigenous tourism initiatives could provide an alternative approach, one that prioritises community-led development and minimises ecological harm (Cheong, 2008). Indigenous-led development models, which emphasise autonomy, land stewardship, and cultural preservation, offer a viable way forward for sustainable development (Etchart, 2017; IIPFCC, 2015; Lastra Landa and Bueno, 2022; Moulton and Carey, 2023).

#### 4.5. Strengths and limitations

This study highlights the value of localised knowledge and community-led environmental responses, contributing to broader discussions on Indigenous-led conservation and environmental justice. While the specific cultural and geographical context of Amantaní may limit the generalisability of findings, this study embraces the perspective

that small-scale, context-specific knowledge is a strength rather than a limitation (Ford and Harris, 2024; Schumacher, 1973; Varma, 2003). The recognition of diverse, place-based epistemologies aligns with pluralist approaches that reject universalist environmental solutions in favour of locally rooted strategies (Escobar, 2011b; Escobar et al., 2022). By centring Amantanian perspectives, this research contributes to broader understandings of how Indigenous communities worldwide navigate environmental change.

The participatory approach ensured alignment with community interests and empowered local voices (Davis and Ramírez-Andreotta, 2021). However, the study was constrained by its exclusive focus on community members, without directly engaging external stakeholders such as policymakers or tourism industry representatives. This limited the scope of discussions on broader structural inequities and policy solutions (Álvarez and Coolsaet, 2020; Davis and Ramírez-Andreotta, 2021). Additionally, using Spanish rather than Quechua in the workshops may have restricted the depth of TEK shared, given the potential for linguistic barriers to influence knowledge transmission.

Future research should explore structural causes of environmental health risks, focusing on policy changes that address these issues at their root (Álvarez and Coolsaet, 2020; Davis and Ramírez-Andreotta, 2021). Collaborative governance models that integrate Indigenous perspectives with external decision-making processes could enhance the effectiveness of conservation and climate adaptation strategies (Davis and Ramírez-Andreotta, 2021). By fostering inclusive, cross-cultural partnerships, future studies can build on the findings of this research to promote equitable and sustainable environmental management solutions.

## 5. Conclusion

This study underscores the critical role of Traditional Ecological Knowledge in promoting sustainable development on Amantaní Island. By centring community expertise, the research demonstrates how TEK can enhance environmental management while addressing both ecological and cultural needs. The findings emphasise the importance of understanding environmental challenges within broader historical and social contexts. Amantaní's case underscores how hyperlocal perspectives enrich global sustainability dialogues, challenging the dominant paradigms of environmental governance and advocating for the recognition of multiple ways of knowing. Going forward, it is essential to strengthen partnerships, foster inclusive governance, and ensure that Indigenous perspectives are integral to policy discussions. Through collaboration, we can challenge colonial legacies, promote epistemic diversity, and build more just and sustainable outcomes on Amantaní island and beyond.

#### CRedit authorship contribution statement

**Brown Laura J:** Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Calderon María:** Writing – review & editing, Project administration, Data curation. **Mannell Jenevieve:** Writing – review & editing, Supervision, Resources, Funding acquisition. **Cortez-Vergara Carla:** Writing – review & editing, Investigation. **Lowe Hattie:** Writing – review & editing. **Abarca Díaz Blenda Milagros:** Writing – review & editing, Investigation, Data curation. **Espezua Renan:** Writing – review & editing, Investigation, Data curation. **Buddry Hannah:** Writing – review & editing, Formal analysis.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.envsci.2025.104093](https://doi.org/10.1016/j.envsci.2025.104093).

## Data availability

This research involves sensitive qualitative data from Indigenous participants. Access may be granted on a case-by-case basis with ethical approval, community consent, and authors' discretion.

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