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RESEARCH ARTICLE

Unseen scars: Understanding the mental health burdens of climate change on indigenous and rural Peruvian women

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Abstract

Climate change is disproportionately affecting the mental health of marginalised populations, particularly women in the Global South. Peru, highly vulnerable to environmental hazards, presents a complex landscape where rural and indigenous women face intersecting ecological and social stressors. This study investigates the nexus between climate change impacts and mental health among underserved Peruvian women. It explores their coping mechanisms, community support systems, barriers to formal mental health services, and potential community-driven solutions. Between April and June 2022, we conducted 48 in-depth walking interviews with adult women from the Peruvian north coast, Amazon rainforest, and central and southern Andes regions. We recruited our participants using purposive and iterative snowball sampling, targeting key community informants. Data were analysed thematically. We identified six main themes: (1) Direct mental health impacts of climate change, manifesting as psychological distress and trauma responses; (2) Complex local issues, including gender-based vulnerabilities and male outmigration; (3) Indirect impacts through livelihood loss and food insecurity; (4) Community coping mechanisms, centred on women's leadership and spiritual traditions; (5) Barriers to mental health support, including institutional mistrust and stigma; and (6) Community-based solutions emphasising culturally responsive interventions. Participants reported acute psychological responses to environmental disasters while demonstrating resilience through adherence to spiritual traditions and social networks, with women emerging as environmental leaders despite facing disproportionate climate-related burdens. This study emphasises the urgent need to integrate mental health considerations for rural and indigenous women into climate adaptation strategies in Peru. Climate change exacerbates social inequities, significantly impacting mental wellbeing

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through the erosion of traditional practices, particularly in Indigenous communities. Culturally responsive, community-based interventions that amplify women's leadership and address structural barriers to mental health care are essential for inclusive, equitable climate solutions.

Author summary

Our research highlights the significant but often overlooked mental health consequences of climate change affecting Indigenous and rural Peruvian women. Through walking interviews with 48 women across Peru's diverse ecological regions, we documented how environmental disruptions trigger psychological distress that intensifies existing social vulnerabilities. Women described experiencing anxiety, depression, and trauma responses following climate events that threatened their livelihoods, food security, and cultural traditions. Despite these challenges, women demonstrated remarkable resilience through spiritual practices and community networks, often emerging as environmental leaders. Conventional mental health services often fail these communities due to cultural insensitivity, institutional mistrust, and accessibility barriers. Our findings emphasise the urgent need for climate adaptation strategies that incorporate mental health support through culturally responsive approaches. By recognising women's leadership capacities and traditional knowledge systems, communities can develop more effective, equitable responses to climate challenges while supporting psychological resilience. This research underscores the essential intersection of climate justice, gender equity, and mental health in developing sustainable solutions for vulnerable populations.

1 Introduction

Climate change and environmental degradation pose existential threats to human wellbeing, with disproportionate impacts on marginalised populations worldwide, particularly women in rural and Indigenous communities of low-and-middle-income countries [1,2]. The intersection of gender inequalities, poverty, and environmental degradation magnifies vulnerabilities, amplifying a range of adverse mental and psychosocial outcomes such as anxiety, depression, and feelings of hopelessness and helplessness [1,3–5].

Climate-related stressors, including extreme weather events, resource scarcity, and ecological disruptions, directly undermine these communities' livelihoods, food security, and cultural practices [1]. Concurrently, pre-existing socioeconomic disadvantages constrain women's ability to effectively prepare for, respond to, and recover from the multifaceted impacts of environmental shocks and stresses [6,7].

In Peru, the effects of climate change manifest through various environmental threats, such as droughts, floods, accelerated glacier retreats, and ecosystem

degradation [8]. These climate hazards disproportionately disrupt the livelihoods, food security, and cultural practices of rural and Indigenous communities, with profound implications for the mental wellbeing of women in these regions [4].The El Niño–Southern Oscillation (ENSO) is a significant driver of these impacts, a cyclical fluctuation in global temperatures and precipitation patterns directly influencing Peru's climate. ENSO has become increasingly extreme due to climate change, with recent research indicating that warming ocean temperatures amplify its intensity and frequency [9]. Over the past three decades, the country has experienced a staggering 167% surge in heat-related work hour losses, with the agriculture sector in coastal regions being notably affected [1,10]. Despite being a country with high biodiversity and cultural diversity, Peru faces significant challenges in addressing climate change impacts [8]. Women's experiences facing these stressors remain understudied, particularly among peri-urban and rural groups in the Global South [11].

Despite efforts to expand healthcare coverage, many Peruvians, particularly those in indigenous communities, continue to face substantial barriers to accessing essential services. These include high out-of-pocket expenses, geographical inaccessibility exacerbated by rural remoteness, and healthcare workforce shortages, further compounded by the COVID-19 pandemic [10,12–14]. Geographical accessibility remains a primary obstacle, with median travel times to primary healthcare facilities being 5.3 times higher in rural areas than urban settings. Moreover, many primary care centres need more staffing, infrastructure, and essential resources like internet connectivity [13]. Climate change further compromises healthcare access through damaged infrastructure from extreme weather events and disrupted transportation routes [15]. Additionally, Peru's national adaptation plans of 2002 and 2015 for climate change fail to include health as a priority or health-related strategies [16].

Mental disorders affect one in five adults in Peru, yet access to mental healthcare has historically been limited, with estimates suggesting a mental healthcare gap ranging from 69% to 85% despite the 2018 mental health policy reform by the Peruvian Ministry of Health [10,12].

The global burden of mental disorders has increased globally due to several interconnected factors, including rapid urbanisation, forced migration linked to environmental degradation, economic instability, and social inequality [17]. Additionally, the growing impacts of climate change are creating new mental health challenges while exacerbating existing vulnerabilities [5]. In Peru, the burden of depressive symptoms and psychosocial distress linked to the COVID-19 pandemic has increased, disproportionately affecting women, youth, and those underserved, underscoring the profound implications of socioeconomic deprivation on psychological wellbeing [18].

Climate change affects mental health through multiple direct and indirect pathways [19]. Direct impacts include the psychological trauma associated with exposure to extreme weather events [3], the physiological consequences of rising temperatures [20], and air pollution [21]. Indirect pathways encompass the disruption of social determinants of mental health, such as loss of livelihoods, cultural heritage, increased poverty and unemployment, biodiversity loss, and distress about future environmental threats [5,22]. These factors interact in complex ways, with disruptions in one domain having cascading effects on other aspects of wellbeing, ultimately culminating in adverse mental health outcomes. The cumulative effect of these stressors creates cascading impacts on mental wellbeing, particularly for vulnerable populations [23,24].

While recent research has focused on the linkages between climate change and mental health globally, limited studies are exploring the lived experiences and multifaceted mental health impacts of environmental stressors on rural and Indigenous women in a highly vulnerable country such as Peru. This study makes a distinctive contribution to the literature by examining the understudied intersection of climate change, gender, and mental health among rural and Indigenous women across four ecologically diverse regions of Peru. While previous research has documented the physical and economic impacts of environmental degradation on vulnerable populations, this manuscript highlights explicitly the psychological dimensions and lived experiences of women facing climate-related stressors. Our qualitative approach shows how environmental disruptions interact with pre-existing gender inequalities, socio-cultural norms, and limited healthcare access to produce unique mental health burdens for women that differ from those experienced by men. Women's traditional roles as caregivers, food providers, and water managers in these communities mean they experience heightened

psychological distress when climate change threatens these responsibilities. Furthermore, this research aims to uncover the psychosocial coping mechanisms and community-based resilience strategies these women have developed despite institutional barriers to formal mental health support. Therefore, we aim to investigate 1) the psychological and emotional toll of climate-related environmental stressors on these women, 2) the coping strategies and community-based mechanisms they employ to navigate these challenges, 3) the barriers they encounter in accessing mental health support services, and 4) the potential for community-driven solutions to promote holistic wellbeing and climate resilience.

By centering the voices and experiences of these marginalised groups, this study provides nuanced insights into the gendered dimensions of climate change impacts on mental health.

To capture these lived experiences authentically, we employed walking interviews as our primary methodological approach, a technique particularly well-suited to exploring the intimate relationships between people, places, and environmental change. This method allows participants to physically navigate their environments while sharing their narratives, providing embodied knowledge of how climate stressors manifest in their daily lives and landscapes. Walking interviews are culturally responsive to Indigenous and rural Peruvian knowledge-sharing traditions through territory connection and honour the deep place-based relationships that characterise these communities' environmental understanding. This approach enabled us to document verbal testimonies and visual and spatial dimensions of climate-related distress that might remain in conventional interview settings.

The findings will inform the development of equitable, culturally responsive mental health interventions and adaptation strategies. This paper reports on qualitative data from 48 adult women living in peri-urban, semi-rural and rural areas across diverse Peruvian regions.

2 Methods

2.1 Ethics

The study received approval from the Peruvian Comite de Etica Prisma ONG (CE0134.22) and the LSHTM Research Ethics Committee (N°26912). All participants provided written informed consent after receiving detailed information about the study's purpose and procedures. Participants were assured of their right to withdraw at any time and of data confidentiality. We curated the data anonymously, assigned a unique code for each participant, and securely stored it on a password-protected university drive, accessible only to the research team. No monetary compensation was given to participants. However, we acknowledged participants' time and shared knowledge by offering refreshments during interviews and providing a lay summary of study findings to interested interviewees upon completion of the research.

2.2 Study setting

Peru ranks third highest globally in biodiversity and is home to 55 indigenous groups, mainly in the Amazon and the Andes, speaking 48 different native languages [25]. This study uses the following definitions for different settlement types: *Peri-urban:* Areas at the interface between city and countryside, characterised by mixed land use and transitional economies [26]. *Semi-rural:* Settlements with some urban characteristics but maintaining significant agricultural activities and natural landscapes [27]. *Rural:* Sparsely populated areas where agriculture is the primary economic activity, often with limited access to services typical of urban areas [28]. To capture the diverse climate and environmental experiences across Peru, we purposefully sampled participants across four distinct geographical regions:

a) Piura Region: This region is located in northwest Peru and is characterised by a dry tropical climate with limited rainfall and temperatures from 15°C-34°C. Environmental challenges include recurrent floods, droughts, heat waves, and coastal erosion. We interviewed mestizo, Spanish-speaking women from eight semi-rural and peri-urban settlements across Cura Mori, Catacaos, and La Union districts, areas significantly impacted by the 2017 El Niño floods [29].

b) Puno Region: This region is situated in the southern Andes and has a cold and dry climate, with average temperatures between −4°C-17°C. Environmental threats include droughts, floods, and freezing temperatures impacting crops. We engaged predominantly Quechua and Aymara Indigenous women residing in high-altitude areas in Amantani Island in Lake Titicaca and El Collao, Puno, and Chucuito districts [30].

c) Ucayali Region: This eastern Amazonian region has a tropical, hot, and humid climate, with temperatures ranging from 22°C-34°C. It faces threats including deforestation, pollution, flooding, and heat waves. Participants were women of mixed heritage and Indigenous Yine and Shipibo ethnicities residing in settlements around 0.5 and 1 days travel by road and river transport from the region's capital city of Pucallpa [31].

d) Ayacucho Region: This region is located in the south-central Andes. Its climate varies from temperate to cold, with average temperatures between 11°C-16°C. This region experiences water scarcity, land degradation, frost events, and wildfires. We engaged Indigenous Quechua-speaking women from eight rural and urban communities in La Mar and Ayacucho districts [32].

Peru is ethnically diverse, home to approximately 34 million people, with an Indigenous population of around 7 million [10]. In 2022, half of women aged 15–49 self-identify as Mestizo (49.3%), referring to individuals of mixed Indigenous and European (primarily Spanish) ancestry. The next largest group is Native or Indigenous (26.2%), comprising the Quechuas, who predominantly inhabit the Peruvian Andes and neighbouring countries, and the Aymaras, concentrated in the southern Andes. Other Indigenous groups include the Asháninka, who reside in the central Andean rainforests and are part of Ucayali, and the Shipibo-Conibo, in Ucayali, in the Peruvian Amazon. A smaller percentage self-identifies as Black, Brown, Zambo (11.1%) or White (7.5%). Asian Peruvians, primarily Chinese and Japanese descent, comprise less than 1% of the population [33].

2.3 Study design

We conducted an in-depth qualitative study using semi-structured individual walking interviews with 48 key female community informants across four diverse regions of Peru. 'Key female community informants' were defined as women actively engaged in local activities such as neighbourhood committees, government programs, subsistence farming, health/women's groups, or self-employment in local/small entrepreneurship. This approach allowed for a nuanced, intimate exploration of participants' lived experiences, perceptions, and interpretations regarding climate change and environmental challenges [34]. Walking interviews, where feasible, provided unique insights into local contexts and enabled participants to showcase their physical surroundings, offering a richer understanding of their daily realities [35]. To ensure privacy and confidentiality during these interviews, participants chose the place and/or route of the walk, selecting locations that would allow for tranquil conversation with minimal proximity to others. Interviewers asked participants to point out specific areas of concern or witnessed environmental change(s) from their homes, work environments, or local communities and how they related to climate change impacts and their perceived changes over time. To protect anonymity, local researchers verified that participants complied with the eligibility requirements but only recorded anonymised ID codes assigned to each participant on all study-related forms. We employed reflective thematic analysis [36].

2.4 Sampling and recruitment

We employed purposive sampling techniques to interview women in peri-urban, semi-rural, and rural communities for 2 months, starting on 25 Apr 2022 until 23 Jun 2022. Eligibility criteria included age + 18, permanent residency in the surveyed area, fluency in Spanish, and willingness and capacity to provide informed consent. Local research assistants initially approached 1–2 key community representatives from each of the four regions until the target of 48 participants was reached. The local research team comprised four research assistants who were residents of the study regions and had

prior experience in community interviewing. They received additional training from the principal investigator (of Peruvian origin) on study protocols and cultural contexts.

A snowball sampling approach was then employed. Each participant suggested 1–2 additional potential informants, who were vetted through internal discussion. The participation rate was high, with only three individuals declining due to time constraints.

Data saturation was monitored through concurrent analysis during fieldwork, with the research team conducting immediate debriefings post-interviews and preliminary analyses to assess when additional interviews ceased to generate novel insights. While our sampling approach captured diverse perspectives across regions, it prioritised thematic saturation over comprehensive territorial representation and should not be interpreted as representative of all Peruvian women's experiences. The interviews were conducted in Spanish from April to June 2022, with a few greeting sentences in Quechua and Aymara in the regions of Ayacucho and Puno. Our sampling approach prioritised accessible communities due to logistical and safety considerations, which may have excluded perspectives from more remote or isolated populations. This limitation should be considered when interpreting the transferability of our findings.

2.5 Data collection

Through group discussions facilitated by the principal author with the research team, we used a collaborative process to develop a thematic topic guide informed by existing literature on gendered environmental health impacts and insights from the local research team. Our approach was informed by the social-ecological systems framework [37] and feminist political ecology [38], which emphasise the interconnections between social and environmental systems and the gendered nature of environmental experiences and knowledge. The guide focused on four main themes: i) Perceptions of climate and environmental issues and their impacts; ii) Gender engagement, risks, and barriers; iii) Local priorities, needs, and responses; and iv) Persistent gaps and assets. Questions explored women's lived experiences with climate change effects, environmental threats, awareness of existing actions, preventive and responsive programs, and sociocultural norms influencing women's participation in preparedness agendas and resource allocation.

The guide underwent pilot testing with partners in Peru and refinements before data collection, providing a structured framework while allowing flexibility in the direction of the conversation. While most participants preferred walking interviews to showcase their neighbourhoods and local environments, a few preferred seated interviews for physical health reasons. The interviews lasted between 40 and 80 minutes, were transcribed using HappyScribe© transcription software, and verified for accuracy by the research team. The analysis utilised the original Spanish transcripts.

2.6 Data analysis

Immediately following each interview, the local research team and the first author engaged in debrief discussions to foster critical reflection, assess thematic saturation, and make necessary adjustments to the topic guide. We employed a combination of deductive and inductive coding methods. Initial codes were based on the topic guide (S1 Text), with new codes emerging during analysis. We followed Braun and Clarke's [39] six phases of thematic analysis: 1. Familiarisation with the data, 2. Generating initial codes, 3. Searching for themes, 4. Reviewing themes, 5. Defining and naming themes, and 6. Writing up results. A preliminary codebook was developed around the four interview domains and refined through iterative transcript coding. We focused on patterns based on environmental factors, geography, age, and participants' scope to capture nuanced constraints, priorities, and opportunities across diverse contexts. Final themes were reviewed with local research partners in Peru to validate interpretations and preserve cross-cultural meaning. Only the final selected quotes were translated into English. Bilingual team members reviewed these translations to maintain accuracy and cultural nuance. All patterns were assessed based on climatic and environmental factors and their perceived changes in time, geographic areas, age, occupation and individual contexts, aiming to understand how risks, threats, and norms manifest uniquely across contexts that shape lived experiences and gendered participation in climate responses.

2.7 Reflexivity and positionality

The research team's diverse backgrounds enriched the study's analytical perspective. The principal investigator, a Peruvian researcher based in the U.K., brought local knowledge and international academic perspectives from environmental health and gender studies. Four locally based research assistants provided essential cultural and linguistic expertise in their regions. This dual insider-outsider positioning, combined with an intersectional feminist theoretical framework [40], enabled analysis that accounted for how gender, ethnicity, class, and other social identities intersect with experiences of environmental change. The research team underwent extensive training to familiarise themselves with study procedures and bilateral discussions on cultural contexts. Regular debriefing sessions were held to foster critical reflection and assess thematic saturation (S2 Text Positionality Statement).

3 Findings

The analysis revealed six interconnected themes: direct mental health impacts of climate change, indirect impacts of climate change, complex local issues impacting communities' mental health, coping strategies and community resilience, barriers to accessing mental health support, and potential community-driven solutions. These themes have several sub-themes/categories supported by illustrative participant quotes. Please see S1 Table for the themes, categories, and codes table illustrating the complex interplay between environmental stressors, cultural factors, and psychological wellbeing among the interviewees.

3.1 Sample characteristics

We included 48 women aged 20–68, all residing in their current location for at least five years. Participants represented diverse community roles, including volunteer leaders, subsistence farmers, neighbourhood committee representatives, government program coordinators, self-employed individuals, and homemakers. We aimed to recruit 12 participants from each region. Table 1 presents participant characteristics, including Region, occupation/community role, education level, self-reported ethnicity, and age range. We identified the interviews using codes based on the Region of residence (PUC: Pucallpa/Ucayali, PUN: Puno, AYA: Ayacucho, and PIU: Piura) followed by the interview number assigned during data collection.

3.2 Direct mental health impacts of climate change

Our findings reveal a range of psychological responses to climate change, varying in intensity and nature depending on the type of environmental stressor experienced.

3.2.1 Heightened psychological distress. The narratives vividly illustrate the severe psychological toll of climate change, with women explicitly linking their distressing emotions and somatic symptoms to environmental stressors. Their descriptions capture the disruptive impacts on mental health and wellbeing, particularly among populations reliant on subsistence agriculture. Women consistently reported elevated levels of psychological distress directly linked to climate change-related stressors like drought or flooding, which resulted in crop/income losses. The nature and intensity of this distress varied based on the impact's type and duration. Drought-related distress is characterised by persistent worry and feelings of helplessness, often manifesting as physical symptoms, and heavy rains or flooding often manifest more acute distress involving fear, anxiety, and trauma-like symptoms. These findings align with emerging research on the differential impacts of acute versus chronic climate stressors on mental health [23,24].

> *"Depressed... of course, one cannot eat, sometimes I was depressed...there was nothing I liked." (AYA-06)*

> *"I am looking at it more than before; it is getting a bit complicated to live like this in these conditions, with water everywhere." (PUC-05)*

Table 1. Sample characteristics.

Natural Region (Department)	ID	Age (Years)	Occupation/ *Community Role*	Education	Ethnicity
Southeastern Andes (Puno)	PUN-01	33	Subsistence farming, eco-tourism host, traditional artisan	Complete Secondary	Quechua
	PUN-02	32	Subsistence farming, eco-tourism host, traditional artisan/ *Delegate - "Glass of Milk" government program*	Complete Secondary	Quechua
	PUN-03	22	Subsistence farming, eco-tourism host, traditional artisan	Complete Secondary	Quechua
	PUN-04	52	Subsistence farmer, small cattle breeder	Incomplete Primary	Aymara
	PUN-05	50	Owner of grocery store, subsistence farmer	No qualifications	Aymara
	PUN-06	22	Teacher (currently between jobs)	Complete Tertiary	Aymara
	PUN-07	68	Pensioner, Subsistence farming	No qualifications	Aymara
	PUN-08	25	Hospitality graduate, law student, intern at district attorney's office/ *Member of local Feminist association*	Complete Tertiary	Mixed/Other
	PUN-09	68	Former municipal mayor, congress candidate, political leader	Complete Tertiary	Mixed/Other
	PUN-10	28	Owner grocery store, trout fish farmer, subsistence farmer	Complete Secondary	Aymara
	PUN-11	54	Owner of grocery store, former trout fish farmer	Complete Secondary	Mixed/Other
	PUN-12	48	Subsistence farmer, former trout fish farmer/ *Former neighbourhood leader*	Complete Secondary	Aymara
Eastern Amazonian rainforest (Ucayali)	PUC-01	46	Homemaker/ *Delegate - "Glass of Milk" government program*	Incomplete Secondary	Mixed/Other
	PUC-02	54	Owner of grocery store, subsistence farmer	Incomplete Primary	Mixed/Other
	PUC-03	37	Obstetrician at the local health centre	Complete Tertiary	Mixed/Other
	PUC-04	37	Owner grocery store/ sells homemade food/ *Voluntary at "Glass of Milk" government program.*	Incomplete Tertiary	Mixed/Other
	PUC-05	26	Housekeeper	Incomplete Tertiary	Mixed/Other
	PUC-06	48	Community health agent/ *Head of local neighbourhood committee*	Complete Technical	Mixed/Other
	PUC-07	49	Independent trader/ *Community health agent/ Treasurer at Local Health Administration Community (CLAS)*	Complete Technical	Mixed/Other
	PUC-08	34	Housekeeper/ Community health agent	Incomplete Tertiary	Quechua
	PUC-09	40	Housekeeper/ *President - local "Glass of Milk" government program & district coordinator for the municipality*	Complete Secondary	Ashaninka
	PUC-10	39	Homeowner, traditional artisan	Incomplete Tertiary	Shipibo-Koniko
	PUC-11	34	Sells homemade food	Incomplete Secondary	Mixed/Other
	PUC-12	30	Deputy Manager of Green Area and Municipal Environmental Management	Complete Tertiary	Mixed/Other
Southcentral Andes (Ayacucho)	AYA-01	55	Housekeeper/ *Volunteer community leader (defence)*	Complete Secondary	Quechua
	AYA-02	60	Subsistence farmer/ Housekeeper/ *President of civil association*	Complete Secondary	Quechua
	AYA-03	50	Subsistence farmer/ Housekeeper/ *President of civil association*	Complete Secondary	Quechua
	AYA-04	30	Subsistence farmer/ Housekeeper/ *President "Glass of Milk" government program/ President local "Juntos" program*	Incomplete Secondary	Quechua
	AYA-05	35	Subsistence farmer/ Housekeeper/ *Prosecutor local "Juntos" government program*	Complete Secondary	Quechua

(Continued)

Table 1. (Continued)

Natural Region (Department)	ID	Age (Years)	Occupation/ *Community Role*	Education	Ethnicity
	AYA-06	35	Owner of grocery store/subsistence farmer/ *Volunteer community leader (defence)*	Complete Secondary	Quechua
	AYA-07	35	Subsistence farmer/ Housekeeper/ *Former president of Women Entrepreneurship Association*	Complete Secondary	Quechua
	AYA-08	50	Primary level teacher	Complete Tertiary	Quechua
	AYA-09	50	NGO director/director of agriculture and Livestock Development Centre	Complete Tertiary	Quechua
	AYA-10	30	Student/ Housewife	Complete Tertiary	Quechua
	AYA-11	60	Coordinator government commission (CNAM)	Complete Tertiary	Quechua
	AYA-12	60	Director regional Indigenous Women Federation/community *leader*	Complete Secondary	Quechua
Northwestern Coast (Piura)	PIU-01	42	Housekeeper/ *President - local "Glass of Milk" government program & Volunteer at "CunaMas" government program*	Complete Primary	Mixed/Other
	PIU-02	59	District Councilor/ *Neighbour Committee leader* & Meal kitchen leader	Incomplete Secondary	Mixed/Other
	PIU-03	43	Lieutenant governor/ Teacher/ *Disaster brigade volunteer*	Complete Secondary	Mixed/Other
	PIU-04	37	Social actor/ *Anaemia surveyor*	Complete Secondary	Mixed/Other
	PIU-05	29	Labourer/ *Social actor*	Complete Secondary	Mixed/Other
	PIU-06	58	President of local soup kitchen/ *Coordinator of disaster drains*	Incomplete Primary	Mixed/Other
	PIU-07	54	Lieutenant governor/ *Leader - "Juntos" government program*	Complete Secondary	Mixed/Other
	PIU-08	33	Secretary school parent's association/ *Street delegate*	Complete Secondary	Mixed/Other
	PIU-09	44	Lieutenant Governor/ Housekeeper	Complete Secondary	Mixed/Other
	PIU-10	34	President school parent's association/ *Leader - "Juntos" government program*	Complete Secondary	Mixed/Other
	PIU-11	20	Volunteer International plan program/ Classroom coordinator	Complete Secondary	Mixed/Other
	PIU-12	42	Labourer/ *President - local "Glass of Milk" government program/ Treasurer classroom* committee	Incomplete Primary	Mixed/Other

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"Psychologically, it traumatises us [the flood memories]...we cried, we cannot sleep, at every moment we felt like something was going to happen." (PIU-07)

3.2.2 Hopelessness and feelings of defeat. The perceived inability to find solutions, make meaningful changes or alleviate their suffering described by participants in the face of worsening environmental conditions is especially troubling. These perceptions perpetuate feelings of defeat and hopelessness and cycles of despair, resonating with broader discourses around the disproportionate climate change vulnerability of marginalised populations with limited adaptive capacities to cope with accelerating climatic impacts. Participants' pervasive sense of hopelessness resonates with Albrecht's concept of *Solastalgia* [41] which describes the distress caused by environmental change impacting one's home environment. Participants were distressed at witnessing environmental degradation, reflecting deep-rooted connections to their landscapes. Their narratives revealed how traditional relationships with the environment extended beyond mere resource dependence, encompassing spiritual practices, cultural ceremonies, and generational knowledge of agricultural patterns.

"Yes, personally, that generates anguish and sadness in me…It gives me a lot of helplessness, sadness, knowing that I, as a person, cannot do anything." (PUN-08)

"Sometimes I also get struck by that stress, sometimes, and... I do not have a solution to that." (PUC-11)

"The frost is affecting us all…sometimes, it is discouraging, right? Like, one does not feel like working in their fields anymore, no more." (PUN-012)

3.2.3 Trauma and emotional distress. The intensity of women's emotional responses, like crying, physical pain, trauma symptoms and suicidal thoughts concerning extreme weather events, underscores the profoundly distressing nature of their experiences with climatic impacts and environmental losses. Their descriptions capture the psychological impacts closely related to trauma responses, highlighting another dimension of climate change's toll on mental health. This aligns with emerging research on *climate trauma* [42] and would indicate a need for trauma-informed approaches in climate change adaptation strategies.

"I truly suffered, miss, in the lake, I cried...[I feel] very stressed, miss...I was stressed, I could not bear it, my head, my head hurt, it hurt a lot, I almost went crazy, miss, from overthinking. That happened to me...I could not sleep, miss, I could not sleep." (PUN-11)

"I felt worried, stressed out. I did not know what to do, then I thought maybe I could buy another piece of land there [in a safer area], where my family could be fine." (PUC-01)

3.2.4 Fear and anxiety linked to future climate impacts. The experience of confronting unpredictable weather changes and enduring the resulting losses has left women in these communities in a state of persistent fear and anxiety about future climate impacts. The constant threat of floods inundating their lands and homes, coupled with concerns about the future of themselves and their families, has created a pervasive sense of dread. This anxiety is exacerbated by the scarcity of essential resources like water, increasing frequency, length and severity of droughts, and disruptions in agricultural production. Uncertainty contributes significantly to the community's overall mental distress, underscoring the urgent need for support and adaptive strategies to mitigate these challenges.

"One feels sad when the products [crops] go bad... You never know if there will be any production or not. Who can be calm when it rains too much? Mentally, you are always worried, thinking about what will happen to your harvest, what will happen to the children..." (AYA-07)

"*Once that happens to you [flooding], someone will always be afraid that something will happen or it will reach their home..people are quite worried, and their mental health is affected." (AYA-04)*

"So, climate change is very concerning, right? I mean, what kind of future will we give our children, right? I feel very worried when there is no rain, you know? Ultimately, I know that the rain will allow me to sustain myself…As a human, I can eat and feed my family, right?" (AYA-11)

3.3 Complex local issues impacting communities' mental health

The intersections of climate change impact with other existing local stressors such as deforestation, illicit crop cultivation, crime, and the presence of "*colonos*" (settlers from different Peruvian regions or countries who acquire Amazonian lands for agriculture and grow cattle)- amplify the respondents' psychological burden and create a complex web of challenges to mental health and wellbeing. Their responses spotlight how environmental issues are intricately intertwined with social, economic, and cultural factors shaping mental health vulnerabilities.

"Here, most people have suffered from the frost too because it has taken away several crops that were not supposed to freeze this season, but they have frozen, and everything is killed…Yes, it is mostly young people and some older people who have tried [ending their life by suicide]. I do not know. I have heard several things. Yes, the concern and the stress are like one thing leads to another." (PUN-06)

"...in our virgin forests, people are already coming to cut down trees, illegally [obtained] woods... tremendous trees have already fallen. They [the colonos] are planting their plants [crops], burning forests, and building roads, destroying the Amazon. It is already a reality that we are being wasted with our forests." (PUC-09)

"*But how are you going to support yourself? Sometimes if you have coca, you are going to choose coca [cultivating illicit crops], like, trying to, as they say, survive." (AYA-07)*

While our findings highlight the intersection of climate change with contemporary stressors, it is essential to recognise that these challenges exist within a broader historical context of colonial trauma. This historical trauma compounds the psychological impacts of climate change, creating what can be understood as a form of climate injustice with deep historical roots. The current environmental crisis amplifies a continuation of historical patterns of exploitation and marginalisation rather than being a novel phenomenon for these communities.

3.3.1 Intersection of gender roles and climate impacts. Climate change appears to reinforce and intensify existing gender inequalities and disproportionate care burdens. The patriarchal nature of these communities and the heightened vigilance and physical labour required to adapt to environmental impacts fall disproportionately on women, reflecting entrenched gender roles. These conditions reinforce their role as primary caregivers under stressful circumstances and reflect on the early assignment of roles, limiting their opportunities and perpetuating the cycle of gender inequality.

"Since the woman stays at home with these sudden weather changes we have, the children are more affected, and the elderly get sick, and we have to take care of the children, our sick ones at home, take them home, make them run, you know, from one place to another, while the father is working [outside]." (PUC-06)

"[When floods and storms occur] It affects us as women because we have to be more careful with the children, more careful with the house…Because in these places, we get flooded. It really affects us." (PUC-07)

"So, in fact, women face a variety of problems [when water is scarce], right? To whom they are delegated, even if we talk about ages, right? Girls not only carry water but also take on other tasks, right? like herding, taking care of younger siblings, um, domestic activities, that when they come home from school, they have to assume more [responsibilities]." (AYA-11)

3.3.2 Environmental economic stress, use of alcohol and substance use as maladaptive coping in underserved communities. The intersectionality of economic hardships, environmental challenges, and mental health issues within these communities has led to an increase in alcohol and substance use, primarily among men. While potentially providing temporary emotional relief, this coping mechanism against stress and economic uncertainty exacerbates existing problems and creates new ones, significantly adding strain to family relationships and impacting family dynamics and overall community wellbeing.

"[With the droughts] Now we are [in a bad economic situation], well, everything [prices] is going up; there is no sales or money for food. (…) for that reason, it's affecting everyone, from the head, from this... everything, everything, people are just drinking [alcohol] as a remedy, right?" (AYA-01)

"[Upon crops failure] Sometimes men drink [alcohol], sometimes women do not like it, sometimes... problems (arise), right?" (PUC-02)

This quote suggests that women bear a disproportionate burden of the negative consequences of increased alcohol use, potentially leading to domestic conflicts and violence and further erosion of family support systems. Moreover, the perception of alcohol use as a predominantly male behaviour reinforces existing gender norms and power dynamics within these communities. This finding aligns with previous research on the relationship between economic stress and increased alcohol consumption in disadvantaged communities [43].

"[Upon current droughts] Some people are worried about the economic situation now, right?" (…) I also see that there are people who drink alcohol, right? So, there are also people who consume alcohol and drink liquor... Men." (AYA-11)

3.3.3 Outmigration/abandonment by males: Psychological impact on family systems. Climate change-induced resource scarcity and socioeconomic adversities have led to significant outmigration of men from these communities, fundamentally altering family structures and community dynamics. This phenomenon creates distinct psychological burdens for women left behind, who experience compound stressors: emotional distress from family separation, anxiety over uncertain returns, and the mental strain of managing expanded responsibilities alone.

"[On men migrating due to droughts] some go for a year, two years, some pass away there [in the host city]." (PUN-03)

This quote links the psychological toll of prolonged separation and uncertainty, where women live in a state of perpetual limbo—unable to grieve properly or move forward, creating conditions for complicated grief and chronic stress.

"Yes, the majority of people [males] have tried to leave because they have become desperate due to the need of each household." (AYA-07)

The "desperation" referenced here reflects not only economic distress but also psychological distress that permeates these climate-affected households. Women repeatedly described feelings of abandonment, resignation, and emotional numbness when discussing male outmigration—psychological adaptations that, while protective in the short term, can contribute to longer-term mental health issues. This widespread outmigration represents a form of maladaptive coping at the community level, which could further undermine the community's adaptive capacity fragmenting family support systems precisely when they are most needed to buffer against climate-related stress.

3.3.4 Lack of support by local authorities. Our analysis reveals a significant disconnect between the urgent needs of communities facing climate change impacts and the response of local authorities. This gap in support exacerbates the psychological toll of environmental stressors and undermines community resilience. Women in these communities have demonstrated remarkable agency in advocating for their needs, such as sending letters, organising community gatherings, and participating in local advocacy groups. These efforts aimed to draw attention to their pressing issues, from inadequate infrastructure to insufficient healthcare services. However, their efforts often meet with disappointment. Many expressed frustration at the slow or unsatisfactory response from authorities. They felt their voices were usually marginalised or ignored, making their struggle for recognition and support an ongoing battle.

"Sometimes that stress also affects me strongly, and sometimes I don't have a solution for that. Or sometimes I just want [practical] support, you know? Because right now, during this flood, a lot of support is needed, especially from the authorities, as you say, that above all" (PUC-11)

"Here, well, you know, we say, right? We are a forgotten town, right? By our authorities... our mayor, right? And when it rains, the streets get damaged, right? The streets get damaged and, well, that's my opinion…For me, I don't think they care, I don't think they care, because I don't see their work, right? I don't see it. They're more focused on other things than looking after the environment." (PUC-08)

This perceived neglect by authorities contributes to a sense of abandonment and powerlessness. The cyclical nature of political promises and subsequent disappointment further erodes trust in local governance.

"Suddenly, one starts to think that they practically ignore us." (PIU-02)

"Well, around here, the authorities are rarely seen...Sometimes they promise you a lot of things, but once they are in government, once they are seated, they don't fulfil them anymore." (PIU-04)

This breakdown in trust between communities and local authorities represents a significant barrier to effective climate change adaptation. It aligns with research [44] on the importance of institutional trust in building community resilience to climate change.

3.4 Indirect impacts of climate change on mental health

The narratives show how climate change indirectly shapes mental health by exacerbating poverty, food insecurity, malnutrition and a sense of cultural/spiritual dislocation as traditional practices are disrupted. Women's longing for sustainable human-environment dynamics points to deeper psychosocial and spiritual impacts, demanding holistic responses.

3.4.1 Impoverishment/Loss of livelihoods due to climate impacts. Climate-induced changes in biodiversity and ecosystems undermine traditional livelihoods, leading to economic stress and associated mental health impacts. Narratives on the loss of plants traditionally used for agriculture and medicine, coupled with the depletion of local animal species and the decline of primary income sources (e.g., trout production, agriculture), pose a significant challenge to their livelihoods and wellbeing. These environmental changes disrupt daily activities, as extreme temperatures and unpredictable weather patterns force them to abandon routines, including school attendance and socialising. These changes highlight how isolation and the erosion of their traditional ways of life exacerbate their growing hardships. Economic disruption appears to be a key pathway through which climate change impacts mental health, aligning with previous research on the mental health consequences of climate-related livelihood loss [22].

"Sure, yes, it generates stress, mostly concern because let's say that we dedicate ourselves mainly to 80% of trout production, and imagine that after that, we won't have a job. That's where you feel the most stress, right? It's practically a disappointment when you see so many trout gone... so much money invested and lost, right?" (PUN-10)

"We no longer lead a normal life. If suddenly today I, I make plans to go out in the afternoon, right? to visit..and since we don't have weather stability, today the rain starts, there are tremendous puddles, we can't move around..it affects us in one way or another, in planting it also affects us because today the weather is nice, an intense sun comes, it kills our crops, so, in one way or another, this climate change is affecting us." (PUC-09)

"The rains, well, sometimes they, I mean, our roads are not abundant, the little houses, the schools, they cannot go to school, we cannot go to a market, do the shopping, all of that." (PIU-12)

"Their meat is finished, sometimes there isn't any, sometimes there isn't even anything for breakfast, what are we going to... there might be rice and maybe oil to mix something with the rice, but you won't find any fish or eggs. Nothing at all." (PUC-05)

3.4.2 Food insecurity due to crops failures. Climate change-induced crop failures have precipitated a complex crisis of food insecurity, intertwining issues of nutrition, cultural/personal identity (i.e., as a farmer), and psychological wellbeing. Our analysis reveals that erratic weather patterns threaten food availability and disrupt deeply rooted cultural practices and traditional knowledge systems. The shift from abundance to scarcity is starkly illustrated in this quote:

"Crops too, now it's not like before, it rots...before it was not like this when the michica local festival] is done, we used to get nice grain. Now it is rotten, everything comes out spoiled...it is not like before." (AYA-01)

The interconnectedness of agricultural practices with cultural festivities suggests that climate impacts extend beyond material concerns to affect community cohesion and cultural continuity. Also, the widespread nature of crop failures was evident. The vulnerability of diverse crops to changing weather patterns indicates a potential loss of dietary diversity that could have significant nutritional implications. This effect also undermines women's ability to provide for their families, potentially leading to feelings of powerlessness and inadequacy. The quotes also highlight the critical role of subsistence agriculture in supplementing household income, suggesting that crop failures may exacerbate economic insecurity. These findings align with research on the complex relationships between climate change, food security, and mental health [22].

"Now the climate has changed a lot; now there is a lot of rain, uh, it ruins the, the crops, it ruins, it affects us a lot, the crop, for example, papaya, cassava, plantain, all the plants, they get spoiled, they fall." (PUC-02)

"In the past, I used to plant my bananas, my sweet peppers, my soybeans, the puspo bean, all that to be able to feed my children because sometimes the money wasn't enough for us, right?... Now, if you want to plant, it doesn't produce, the plants dry up." (PUC-07)

There was also an awareness of the differential impacts of food insecurity, particularly on vulnerable groups like pregnant women and young children. This understanding of the long-term health consequences of malnutrition adds another layer of stress to their experience of food insecurity.

"Suddenly there's no daily food, as they consume here, and we are concerned because the need for adequate nutrition is more pronounced, right? This affects pregnant women and children under five years old, right?" (PUC-03)

3.4.3 Ecosystem/landscape degradation. Women recall times when rainfall patterns were more predictable. Their past ability to plan and adapt as part of their interconnectedness with nature indicates a deep sense of loss and nostalgia for a balanced relationship with the environment. Our analysis reveals a profound loss and grief associated with the degradation of local ecosystems and landscapes. This environmental deterioration is not merely a physical change but represents a rupture in the women's relationship with their environment, challenging their sense of place and identity. This narrative also illustrates the Solastalgia concept [41]. The emotional impact of ecosystem degradation is captured in this quote:

"I don't like passing through the Bay of Puno. I feel it is quite a sad scene. It is so polluted. There is the presence of lentil [Lemna gibba or invasive duckweed]...an algae that grows due to pollution, right? and as this plant grows, it further contaminates Lake Titicaca. So I avoid this area because also, at a certain time, it smells bad, and that depresses me quite a bit." (PUN-08)

The participants highlighted the interconnectedness of different environmental processes, such as linking deforestation to water scarcity and how changing rainfall patterns alter familiar seasonal rhythms and disrupt agricultural practices, potentially challenging traditional ecological knowledge systems. They also convey a sense of disbelief at the scale and speed of irreversible changes, coupled with frustration at the lack of broader recognition of the problem. These findings align with previous research [45] on the psychological impacts of ecosystem degradation, highlighting the need for climate adaptation strategies that address physical environmental changes and their impacts on community members' sense of place and identity.

"There are streams that are drying up…They were huge streams that never dried up, but unbelievably, due to deforestation, they are drying up." (PUC-09)

"Before it was, well, since it used to rain more before, in the month of September, October, already, the farm was already normal, normal, green, from here we harvested a lot of beans, those things also existed, now not anymore." (PUN-01)

"Yes, I think every day, and we also experience it firsthand, right? I mean, it's not just hearing about it, but what you live. if you see Lake Titicaca, it has never recovered its flow; never, you will see how the lake has receded enormously, and nobody realises that." (PUN-09)

3.4.4 Cultural and spiritual practice losses. Women expressed a broader concern that traditional cultural practices, such as craftwork, are being abandoned in favour of more pressing economic needs, contributing to the erosion of cultural heritage, as these practices can no longer be prioritised amid extreme challenges. Introducing new religious practices and lacking recreational spaces have altered traditional religious festivities, which once served as vital community gatherings and spiritual and social engagement sources. Climate change and associated socio-economic impacts are catalysing a profound cultural shift in these communities. This erosion of cultural heritage represents a loss of traditions and a fundamental challenge to community identity and social cohesion.

"They are more worried, since they don't do crafts anymore, nor do they, so agriculture is already their livelihood so that they can live, right?" (PUN-03)

There is a nuanced understanding of the trade-offs involved in development, suggesting that community members are not opposed to change per se, but are concerned about the loss of cultural and environmental values in the process.

"That's it. Yes, there are plenty of things being destroyed precisely because of development, and so I believe that development must be accompanied by care for the environment, care for culture, which is what is disappearing." (AYA-03)

Interviewees mentioned multiple factors, including changing religious practices and a lack of communal spaces, altering the fabric of community life. The erosion of cultural practices may have significant implications for community mental health, as these traditions often serve as coping mechanisms and sources of resilience in the face of environmental and social changes. These findings align with other research on the impacts of climate change on cultural heritage and indigenous knowledge systems [46].

"There is a lot of lack of recreation space that we have to create. Surely there are ways, the religious festivities that made them a little, right? distract themselves, it has changed completely because in the communities the evangelical religion has entered." (AYA-09)

3.5. Coping strategies and community mechanisms

3.5.1 Reliance on spiritual and cultural traditions. Women's reliance on spiritual practices like rituals, prayers, and the use of traditional plant medicines highlights the cultural grounding of their coping strategies and the need for mental health responses that resonate with local worldviews. Their spiritual connectedness to the land suggests that environmental changes disrupt psychosocial wellbeing at deeper levels, requiring holistic interventions bridging mind-body-spiritual dimensions.

"Also, let's see, therapies, with my partner before we used to meditate…sometimes he helped me with plants, like, like the Mapacho, which is pure tobacco, not the cigarette there...Um, also, the Huachuma, San Pedro, do you know? The San Pedro, the seven roots too." (AYA-10)

"I surrendered to God, I gave everything, my burdens, my worries, everything. From there began a change in my life. I started living a happy life, a joyful life, you know? serving God." (PUC-01)

"We leave it there; we only ask Pachatata, Pachamama, to help us, right? Praying is also the only thing we have left." (PUN-03)

3.5.2 Social networks and individual/family strategies. The interviews revealed the critical role of social support networks in women's coping strategies and emotional wellbeing linked to climate-related stressors. These networks operate at multiple levels - individual, family, and community - providing emotional support, practical help, and opportunities for stress relief. Intimate talks with their partners, telephone calls with family and relatives, and social interactions within the community were common coping mechanisms women used to handle stress and worry and find comfort during difficult situations. However, loneliness and grief were also expressed when family members or partners passed away, missing those important interactions and facing challenges alone. Social support networks were crucial in women's coping strategies and emotional wellbeing, and social connections serve as emotional outlets that allow for catharsis and renewal.

"What I used to do is make a phone call, and when they [loved ones] gave me encouragement, I started to cry...and I said okay, everything is out now, and I have to start again." (PUC-09)

The value of changing one's physical environment and engaging in social interactions as stress-relief strategies were evident, suggesting that even brief departures from the immediate stress-inducing environment can benefit mental wellbeing.

"I go out... to distract myself a little, I go out to the city or talk to someone so as not to be stressed, a little of that, right?" (PUC-11)

"Sometimes someone tells me "I'm going to come to visit", they come, with them I relax, with them, I talk, or else I go to the countryside, to the farm, there are people there, with them I talk, I distract myself with them, I forget everything" (PUN-04)

"I talk to my partner…you go out to the countryside, I mean, you leave your house to go to the countryside, and there you forget…you laugh, you talk, you get rid of worry…and so you forget a little" (AYA-06)

However, it's important to note that social support networks may also be vulnerable to climate-related disruptions, mainly through displacement, loss of community members or key support figures, and the potential vulnerability of individuals who may be socially isolated. This points to the need for formal support systems that complement and reinforce informal social networks, ensuring access equity for all community members in the face of climate-related stressors.

3.6 Barriers to accessing formal mental health support

While general healthcare providers are present to varying degrees across the study regions, with some communities having basic access and others facing significant geographic barriers, specialised mental health services are consistently limited or entirely absent throughout all study areas. Even in localities where primary healthcare is accessible, public mental health specialists are rarely available, and general practitioners typically lack training in addressing psychological issues

or recognising somatic symptoms of distress. This creates a significant gap in mental healthcare provision, particularly for climate-vulnerable populations.

3.6.1 Profound mistrust of public institutions. Women expressed a deeply entrenched mistrust of government and public institutions regarding both climate relief support and healthcare access, with significant implications for health and mental health care-seeking behaviours. This mistrust has developed through repeated experiences of unmet promises and disappointments, cultural insensitivity and perceived mistreatment.

"We do not receive anything, no, no, we get no help, and we do not believe in anything the authorities say they are going to do [to support]. No, no. I mean, we are tired of asking. What else can we do?" (PIU-07)

This institutional mistrust extends specifically to healthcare settings, acting as a significant barrier to accessing formal mental health support, leading to a reliance on traditional remedies and home treatments and avoidance of professional clinical care. Despite acknowledging the presence of general healthcare professionals where available, they express concern about the lack of consistent care and accessibility, especially for remote communities. The narratives highlight the perception that hospitals exacerbate rather than alleviate suffering, contributing to avoidance behaviour and self-medication. This reluctance reflects a broader systemic issue of inadequate service provision.

"We have tried at home, with our vegetables that my dad, my mom always teaches me about. With that, we have treated them. That is why we haven't taken my mom to the hospital either" (PUC-10).

This quote directly indicates the decision to avoid institutional healthcare based on mistrust and illustrates a reliance on community-based approaches, traditional healing methods and an intergenerational transfer of knowledge about these practices, seen as more trustworthy and culturally appropriate than formal healthcare services.

"I don't like going to the hospital...I don't like it. I think that I don't know, it makes me sadder, it seems to make you worse, like, you have more worries...no, they don't attend to you... And, if someone is dying, they can't even attend to that yet, that's how it is in the hospital" (PUN-04)

The statement that hospitals "make you sadder" and "make you worse" exemplifies how healthcare institutions are perceived not as sources of support but as exacerbators of mental distress, fundamentally undermining trust in formal mental health care.

This institutional mistrust is further reinforced by experiences of disrespect and blame from healthcare providers:.

"Sometimes when you go there, they shout at you, "Why don't you take care of yourself?"?.. "No, they don't care for you...it's very difficult here..." (PUN-06)

"I don't go to the health center...and if they go to an emergency, they take a long time, they don't attend to you just like that, they don't attend to you quickly. They take (a lot of) time, plus they get upset, the nurses themselves are rude" (PIU-05)

Mistrust translates into avoidance behaviours, creating significant barriers to accessing healthcare. The interviews pointed to broader issues of inadequate healthcare infrastructure, staffing, and a pervasive culture of disrespect toward patients. These findings align with other research on the importance of cultural safety in healthcare settings, particularly for indigenous and rural communities [47]. They underscore the need for systemic changes in healthcare delivery, including cultural competency training for healthcare providers, integration of traditional healing practices, and community-based

healthcare models that can rebuild trust and improve access to health and mental health services linked to environmental crises.

3.6.2 Stigma surrounding mental health issues. In rural and Indigenous communities, the stigma surrounding mental health remains a significant barrier to seeking professional help and support. Deeply rooted in cultural beliefs, social norms and personal perceptions, stigma can lead to misconceptions about mental health and reluctance to engage or address mental health issues with psychological support services.

The association of mental health care with severe mental illness is prevalent and this belief likely prevents many from seeking help for more common mental health concerns, such as anxiety or depression related to climate stressors. Also, the fear of social judgement was evident.

> *"They have never seen a psychologist because the people here say that if you go to the psychologist, you're crazy... they have that idea." (PIU-03)*

> *"They sometimes say, no, I don't have time to go to the health center or that, I will not go waste my time with this...or if I go to a psychologist, they will say I'm crazy or I'm mentally retarded and all that" (PIU-11)*

The narratives show how stigma operates locally through fear of social judgement and labelling. The use of terms like "crazy" and "mentally retarded" highlights the negative and potentially derogatory language associated with mental health issues in these communities.

There's recognition of the stigma's widespread nature and awareness of the problem, at least among some community members:

> *"In Puno, mental health has been heavily stigmatised, with the belief that if you go to a psychologist, you're crazy or have mental problems, which is not the case." (PUN-08)*

These findings align with global research on mental health stigma, highlighting the need for community-based mental health awareness programs that can challenge misconceptions, normalise help-seeking behaviours, and promote a more nuanced understanding of mental health and wellbeing [48].

3.6.3 Limited availability and cultural relevance of services. Our findings show significant structural and economic barriers to accessing mental health services, compounded by a lack of culturally relevant care options. These barriers result in inadequate mental health support, potentially exacerbating the psychological impacts of climate change and other stressors. The dire consequences of limited mental health services are evident, particularly for vulnerable groups like youth:

> *"There should be psychologists at least so that... for the youth, recently a boy died, he poisoned himself [suicide]." (PUC-02)*

Financial constraints prevent access to many mental health services, even when available. This underscores the need for free or low-cost support options in these communities.

> *"No [they do not go], because sometimes they don't have the economic means to go" (PUC-03)*

The narratives highlight a broader issue of inadequate healthcare services, which likely extends to mental health care. The interviewees indicated a profound lack of faith in the healthcare system's ability to meet even basic needs, forcing reliance on potentially inadequate public health services. These findings align with research on the challenges of providing mental health services in rural and low-resource settings [49].

"No, they don't take care of you... And even if you're dying, they still can't take care of you, that's how it is in the hospital" (PUN-05)

"Well...because mostly here the community is poor, and sometimes there is nothing for them, there is nothing to go out to, that is, to other private doctors. No, there is no way to pay for the consultations; we just have to resort to the Health Center" (PIU-12)

3.7 Community-based solutions

3.7.1 Culturally responsive interventions leveraging local assets. The findings underscore the potential for community-based solutions capitalising on existing local assets, particularly women's traditional coping mechanisms and leadership roles. Women's deep understanding of community dynamics and challenges derived from their lived experiences, positions them as key leaders within these communities. They often take the initiative to address local issues, such as infrastructure and safety, and mobilise resources for general wellbeing. This aligns with ecofeminist theories [47] highlighting women's unique environmental knowledge due to their often close relationships with natural resources. Additionally, the interviewees' quotes reflect a strong sense of community solidarity and shared responsibility facing climatic stressors, even considering long-term, intergenerational climate change impacts.

"Since I came to live in this settlement, I started gathering the neighbours to form a board of directors because there was concern, you know? There were no paved streets, they were closed, the drains too...it was dark, there were assaults, rapes." (PUC-06)

"Those of us who form a committee, we are always women. So, how can I put it, I believe that as women, we are the ones who know the most about the issues here in our community." (PIU-07)

"And I, I have a purpose with many people. We must continue to support" (PUC-09)

"Yes, as a mayor, I have also been a leader there. You have to convince people, talk to them, and tell them what will happen in the future, right? And what are we leaving for our children? I always say that" (PUN-09)

The findings suggest that leveraging these existing leadership structures could enhance the effectiveness of climate change adaptation and mental health interventions.

3.7.2 Empowering women's leadership and voices. Despite facing additional stressors, such as the impact of the pandemic and balancing multiple responsibilities, women demonstrated a strong sense of dedication and resilience in their efforts to contribute to community development. Their lived experiences with environmental disasters and the intrusion of extractive industries on ancestral territories have fostered a deep sense of identification with environmental causes, strengthening their commitment to environmental protection and advocacy. The findings highlight the unique perspective that Indigenous and rural women bring to climate change adaptation efforts, rooted in their direct experiences with environmental degradation. Centering women's voices and experiences in climate change policies and interventions could lead to more effective and culturally appropriate solutions.

"So, Indigenous, rainforest, and aboriginal women have lived through the destruction of the land, they have experienced deforestation, so they feel more identified because they have seen environmental disasters in person, they have lived through it, they have survived the destruction of the jungle, they have survived as mining companies have gone and destroyed their rivers, their ecosystems." (PUN-08)

"No revolution in the world would have been possible without the participation of women." (PUN-09)

"Ah, women also have to gather, talk, because when we talk, we solve everything. If we don't gather? Then nothing." (AYA-01)

"Well, mostly women, because sometimes we, um, we gather, you see, when sometimes there's nowhere to go or nothing to buy due to the floods, sometimes we gather, we make communal meals [olla comun], and we take care of the children with this."(PIU-12)

3.7.3 Strengthening community-driven environmental efforts. The narratives reveal existing community-driven efforts to address environmental issues like waste management, river cleaning, flood prevention, etc., with women playing vital roles in mobilising these initiatives.

"We are always present...every month we get together, we clean our rivers, our streets, we collect garbage."(AYA-04)

This quote exemplifies the proactive approach women are taking in environmental stewardship. Strengthening and expanding such efforts could synergistically promote environmental sustainability and community wellbeing. Moreover, integrating mental health support within these community-based environmental programs represents a promising approach to holistically addressing the psychological impacts of climate change.

"Here, I have made women move forward because before, when I came, no…There's only one man in volunteering, of the 20 of us, there's one man... we also coordinate with the mothers from the soup kitchens to support us (on health issues)" (PIU-03)

This quote illustrates how women's leadership in environmental initiatives extends to health-related community support, suggesting potential avenues for integrating mental health services into existing community structures.

4 Discussion

4.1 Theoretical framework: Feminist political ecology of climate and mental health

Our analysis is grounded in feminist political ecology (FPE) and complemented by environmental justice and decolonial perspectives. This integrated framework highlights how gender, power, and colonial legacies shape experiences of climate change and mental health among rural and Indigenous Peruvian women (See Fig 1 for a scheme of the proposed FPE framework).

FPE examines how gendered power relations mediate environmental experiences, resource access, and knowledge production. In our context, this lens helps explain women's disproportionate climate burdens alongside their environmental leadership. The framework recognises that environmental knowledge is embodied and situated in specific social contexts, explaining our participants' unique understanding of environmental changes through their daily experiences and traditional knowledge systems.

By incorporating environmental justice perspectives, we analyse how climate burdens are unequally distributed by gender, ethnicity, and socioeconomic status. This contextualises our findings on disproportionate mental health impacts experienced by rural and indigenous women. Additionally, decolonial theory helps us interpret the profound institutional mistrust reported by participants as rooted in colonial histories and ongoing patterns of marginalisation rather than simple service delivery failures.

This framework acknowledges intersectional vulnerabilities and women's agency in developing adaptation strategies, aligning with our findings on community-driven solutions. Through this theoretical lens, we can better understand how historical environmental exploitation and marginalisation patterns continue to shape contemporary experiences of climate-induced psychological distress.

This directed acyclic graph illustrates the integrated theoretical framework proposed in the study. It combines Feminist Political Ecology, Environmental Justice, and Decolonial Theory to analyse links between climate change impacts and mental health outcomes among rural and Indigenous Peruvian women.

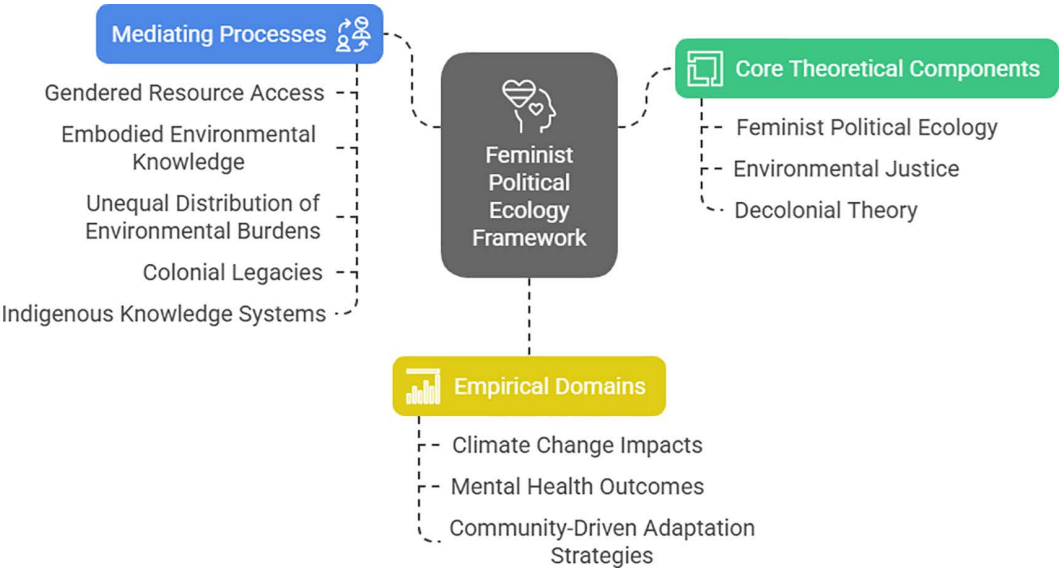

Fig 1. Theoretical framework scheme: Feminist political ecology (FPE) of climate and mental health.

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4.2 Main findings

This study offers nuanced insights into the multifaceted impacts of climate change on the psychosocial wellbeing of women living in rural and peri-urban communities in Peru. The findings uncover three interconnected pathways linking climate change, mental health, and community-based solutions by triangulating perspectives across different regions: 1. Climate Distress and Community Coping; 2. Institutional Barriers and Access to Mental Health Support, and 3. Community-Driven Climate Resilience Solutions. These pathways provide a holistic understanding of how climate change affects the mental health of marginalised women and how they navigate these challenges within their sociocultural contexts.

4.2.1 The psychological toll of climate change. The study's findings underscore the severe psychosocial toll of climate change on rural and peri-urban Peruvian women. Participants consistently reported heightened psychological distress directly linked to environmental stressors, ranging from sadness and anguish to more severe manifestations like insomnia, loss of appetite, and suicidal ideation. These findings align with growing research on the mental health consequences of climate change, particularly for populations reliant on subsistence agriculture [50,51]

The intensity of emotional responses, such as crying, physical pain, and trauma-like symptoms, suggests that climate-related experiences are inducing a profound sense of ecological grief and solastalgia - the distress caused by environmental change [45]. These narratives underscore the deeply distressing nature of the participants' experiences with climatic impacts and ecological losses. Solastalgia among Indigenous communities is intensified by their traditional environmental connection, where landscape changes represent more than physical alterations – they signify disruptions to cultural practices, spiritual traditions, and generational knowledge systems [3,41]. This dimension suggests that mental health interventions and climate adaptation strategies must acknowledge and incorporate these deep-rooted environmental relationships to promote community resilience.

The sense of hopelessness and defeat expressed by many participants highlights the psychological burden of navigating climate impacts with limited resources and support. While our study focused exclusively on semi-rural, rural and Indigenous women, their experiences align with broader literature documenting how socioeconomic marginalisation and gender inequalities can amplify climate vulnerability [52]. This feeling of powerlessness in the face of escalating environmental challenges is particularly concerning, as it may lead to a cycle of despair and inaction, further exacerbating their

vulnerability. Our findings thus contribute to this body of knowledge by providing rich qualitative insights into how these documented vulnerabilities manifest psychologically among our specific study population.

4.2.2 Intersecting gendered burdens and vulnerabilities. Through an intersectional lens, we observe how gender interacts with other social determinants to shape climate vulnerability and mental health outcomes. Women face compounded expectations and responsibilities within their households and communities, including increased caregiving duties for children and the elderly alongside active involvement in responding to climate-related challenges. These gendered burdens align with research identifying several risk factors for mental health problems following weather events, such as being pregnant or postnatal, having prior experiences of deprivation, and occupying first responder roles [24,53].

The risk of gender-based violence is heightened in the context of climate change, further compromising women's safety and wellbeing [24]. Participants' experiences also reflect a growing phenomenon of violence against women environmentaldefenders in Latin America [54].

These psychological burdens are exacerbated by prevailing inequalities, vulnerabilities, and constraints that women face in accessing essential services and formal mental health support [4,5,54]

4.2.3 Overcoming institutional barriers to mental health support. The study showed significant barriers to accessing formal mental health support, primarily due to institutional distrust and systemic challenges. The profound lack of trust in public institutions, stemming from past experiences marked by cultural disparities and perceived mistreatment, aligns with literature on the historical marginalisation of indigenous and rural communities in healthcare systems [55]. Our findings must be understood not simply as manifestations of patriarchal social structures but as reflections of intersecting systems of oppression with colonial origins. The disproportionate impacts of climate change on indigenous and rural Peruvian women represent an extension of historical patterns of environmental exploitation and social marginalisation dating back to colonial periods. Women expressed a deep mistrust of government and public authorities, often feeling abandoned, betrayed by false promises, and disappointed in their lack of support for climate action and community needs. This mistrust led many to rely on traditional remedies and home treatments rather than seeking medical assistance, even when healthcare professionals were available. The perception that hospitals can exacerbate rather than alleviate health concerns contributes to avoidance behaviour and self-medication. This finding highlights the urgent need for a rights-based approach to healthcare that addresses historical injustices and power asymmetries to rebuild trust and enable effective mental health service uptake. The reluctance to seek mental health care also reflects broader systemic issues of inadequate service provision in rural areas, resonating with global mental health service delivery challenges for Indigenous and rural populations [56]. Additionally, the stigma surrounding mental health issues presents a significant barrier, consistent with research on mental health stigma in low- and middle-income countries [57]. Negative stereotypes and social exclusion associated with mental health conditions, particularly for women, further compound the access challenges. Addressing these barriers will require a multifaceted approach that includes improving the cultural competence of service providers, reducing stigma through community education, and developing innovative service delivery models acceptable to local populations, utilising a compassionate approach grounded in Latin American cultural values [58].

4.3 Toward an intersectional, gender-responsive climate policy agenda

The study's findings underscore the importance of considering how gender intersects with other axes of marginalisation to shape mental health outcomes and community resilience. Age, socioeconomic status, ethnicity, and geography are crucial in determining women's vulnerability to climate change impacts and their ability to access support. This intersectional lens aligns with feminist approaches to climate justice and intersectionality [59]. For instance, the study revealed that young women face challenges negotiating reduced workloads during hot periods or obtaining extra support when facing climatic hazards. This vulnerability is linked not only to gender relations that favour men as household heads but also to the mechanics of poverty and scarcity. Future interventions must consider these intersecting factors to adequately support the

most vulnerable populations. This approach is key for ensuring that climate policies and programs are equitable, inclusive, and responsive to the diverse needs and lived experiences of those most affected by environmental change.

4.3.1 Women's agency and community-driven climate resilience. Despite facing multiple challenges, women community representatives demonstrated remarkable agency and leadership in grassroots initiatives addressing environmental issues. The centrality of women in community-driven efforts addressing environmental issues like waste management, water security, and disaster risk reduction reflects their lived experiences and positions them as key assets for community-based, gender-responsive interventions. These initiatives address practical environmental concerns while fostering a sense of agency and social cohesion, potentially mitigating the psychological impacts of climate change. This finding supports literature on the role of collective action in building community resilience to climate change [60].

Women's reliance on spiritual practices and traditional knowledge, including plant medicines, underscores the cultural grounding of their coping strategies and highlights the need for mental health interventions that resonate with local worldviews [61]. This finding aligns with research emphasising the importance of Indigenous knowledge systems in climate change adaptation [62].

Women's deep understanding of local ecosystems and traditional practices offers potential avenues for developing culturally appropriate mental health interventions. Their community-driven efforts highlight the potential for synergistic promotion of environmental sustainability and community wellbeing. Integrating mental health support within these community-based environmental programs represents a promising approach to holistically addressing the psychological impacts of climate change. This aligns with the growing recognition of integrating indigenous knowledge into climate change adaptation strategies [46] and the central role of women in climate change adaptation and resilience-building [63].

4.4 Policy implications and recommendations

The findings of this study offer several critical policy implications to address the mental health impacts of climate change on women in Peru:

1. Prioritise Culturally-Responsive, Community-Based Mental Health Interventions. Service delivery models should be designed in collaboration with women and leverage existing community assets and traditional coping mechanisms. This approach aligns with global calls for community-based mental health interventions in low-resource settings [17]. Interventions should integrate spiritual and cultural practices, recognising their importance in women's coping strategies.
2. Promote Women's Leadership in Environmental Governance and Climate Action. Empowering women to assume decision-making roles and shape the agenda for climate resilience can enhance the effectiveness and equity of these efforts. This recommendation is supported by research demonstrating the positive impact of women's leadership on environmental outcomes [64]. Policy efforts should target gender disparities to enhance mental healthcare access and maternal services while integrating women's leadership to bolster cultural relevance and community empowerment.
3. Address Structural Barriers to Mental Healthcare Access. Rebuilding trust in public institutions, reducing stigma, and improving the cultural competence of service providers is crucial for ensuring that marginalised women can access the support they need. This aligns with global mental health initiatives focused on reducing treatment gaps in low- and middle-income countries [65]. Efforts should include training health and mental health workers on the mental health impacts of climate change and developing skills to differentiate clinical from non-clinical presentations of climate distress.
4. Adopt an Intersectional, Gender-Responsive Approach to Climate Policy. Climate change adaptation and mitigation strategies must account for how gender intersects with other axes of marginalisation to shape mental health outcomes and community resilience. This recommendation is grounded in feminist approaches to climate justice and

intersectionality theory [59] and the need for gender-sensible intersectoral work agendas in environmental health in Peru [66]. Policies should prioritise the needs of the most vulnerable groups, such as youth and older women.

5. Strengthen Community-Driven Environmental Efforts. Supporting and expanding existing community-led initiatives can synergistically promote environmental sustainability and community wellbeing. Integrating mental health support within these programs represents a promising approach to holistically addressing the psychological impacts of climate change.
6. Invest in Education and Awareness. Develop targeted educational programs to raise awareness about the mental health impacts of climate change and available support services. These programs should be culturally sensitive and use local idioms of distress to facilitate communication between health workers, service planners, and community members.

4.5 Limitations and future research directions

This study has several limitations that should be acknowledged. Due to our purposive sampling approach, which focused on women actively engaged in local activities and community representation roles, our findings regarding resilience, leadership capacities, and adaptive strategies may potentially underrepresent more marginalised women who face greater barriers to community participation. Language barriers and cultural differences may have impacted data interpretation despite efforts to conduct interviews in participants' preferred languages. While interviews were conducted in Spanish as the common language across regions, this methodological choice potentially limited participants' ability to express concepts more naturally articulated in indigenous languages such as Quechua, Aymara, and Amazonian languages. Similarly, our analysis applied Western academic concepts like 'solastalgia', which, although helpful for contextualising findings within broader literature, may not fully capture or may even obscure Indigenous ways of understanding human-environment relationships and associated distress. Future research should prioritise data collection in Indigenous languages with appropriate translation protocols and the identification and validation of indigenous conceptual frameworks for understanding climate-related psychological experiences. Additionally, while valuable, the study's focus on women's perspectives may not capture the full range of community experiences with climate change and mental health. While our qualitative methodology allowed for rich exploration of participants' experiences, future research would benefit from incorporating validated psychometric measurements to quantify psychological distress levels and enable comparison with other populations affected by climate change.

Future research should explore the intersectionality of gender with other social identities to understand better how multiple factors shape women's experiences of climate-induced mental health impacts. Longitudinal studies tracking changes in women's mental health in response to climate change would provide valuable insights into cumulative effects and adaptive strategies. Also, our study did not include harder-to-reach Indigenous communities. These populations likely experience distinct climate-related mental health impacts due to their unique relationship with forest ecosystems and different livelihood patterns. Future research should prioritise developing culturally appropriate and ethically sound methodologies to include these perspectives, recognising the additional ethical considerations and specialised approaches required when engaging with these communities. Additionally, comparative studies across different regions of Peru could help highlight context-specific vulnerabilities and resilience factors.

Engaging in community-based participatory research could foster collaboration and empowerment while ensuring that research priorities align with community needs and perspectives. This approach could help address some of the current study's limitations by more fully involving community members in the research process and interpretation of findings.

Investing in capacity-building initiatives to empower local researchers, community leaders, and healthcare providers to conduct culturally sensitive qualitative research on women's mental health and climate change adaptation is crucial for building a sustainable research agenda in this field. This could include training in qualitative methods, ethical considerations in mental health research, and approaches to integrating indigenous knowledge into research designs.

5 Conclusion

As global temperatures continue to rise and extreme weather events become more frequent, the mental health impacts of climate change will likely intensify, particularly for vulnerable populations like rural women in low-resource settings. This study underscores the urgent need for action to support these communities in adapting to climate change while promoting mental health and wellbeing. By adopting holistic, community-driven approaches that recognise the complex interplay between environmental, social, and psychological factors, we can work towards building more resilient and equitable communities in the face of climate change.

Supporting information

S1 Text. Topic guide interviews. The guide focused on four main themes: (i) perceptions of climate and environmental issues and their impacts; (ii) gender engagement, risks, and barriers; (iii) local priorities, needs, and responses; and (iv) persistent gaps and assets.
(DOCX)

S2 Text. Positionality statement. The research team's diverse backgrounds enriched the study's analytical perspective. A dual insider–outsider positioning, grounded in an intersectional feminist theoretical framework, enabled analysis sensitive to how gender, ethnicity, class, and other social identities shape experiences of environmental change.
(DOCX)

S1 Table. Themes, categories,codes. This table presents six interconnected themes identified in the analysis, categories, and codes highlighting the complex interplay between environmental stressors, cultural factors, and psychological wellbeing among the interviewees.
(DOCX)

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