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Research article

Gender and the environmental health agenda: A qualitative study of policy, academic, and advocacy perspectives in Peru

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ABSTRACT

Introduction: Women, especially those living in low-and-middle-income countries experience increased exposure to and impacts of environmental threats. Peru is especially susceptible, with high levels of pollutants associated with extractive industries, and climatic-related disasters exacerbated by climate change. International policies and movements are increasingly calling for a gendered approach to environmental health. We aimed to understand the current Peruvian research, advocacy, and policy landscape at the environment-gender-health nexus.

Methods: We held 18 in-depth semi-structured interviews with key informants from the Peruvian Government, academia, and non-governmental organizations to explore how a gender-sensitive approach and interdisciplinary environmental health collaborations are delivered. We used thematic analysis to compare gender approaches, priorities, and barriers/facilitators to delivering projects within this nexus.

Results: We remotely interviewed 6 representatives of each sector between July 2020 and March 2021. Interviewees mentioned the detrimental role of weak institutions, multilevel corruption, and the lack of interdisciplinarity and intersectorality across environmental health programs and research. They described several barriers to successful collaboration across organizations and sectors, including funding scandals related to extractive economies, high staff turnover impairing long-term program implementation, and machismo culture in organizations and communities. Women's empowerment was described as important for successful program delivery, especially in female-led associations. Some interviewees emphasized the invisibilization of vulnerable groups, such as girls, teenagers, pregnant women, victims of gender-based violence, and LGBTQI+ people.

Conclusions: These qualitative findings highlight the multiple and inter-related contextual issues faced by environmentally threatened communities in Peru, and how macrostructural barriers contribute to a paucity of sustainable, gender-oriented, environmental health projects.

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Abbreviations: GBV, Gender Based Violence; Global North, The industrialized high-per-capita income national political economies of which the majority are in the Northern Hemisphere; Global South, Those countries with high levels of poverty and comparatively low levels of industrialization, large numbers of which exist in the Southern Hemisphere; IPV, Intimate Partner Violence; LGBTQI+, Lesbian, gay, bisexual, transgender, queer and intersex persons; LMICs, Low- and middle-income countries; NGO, Non-Governmental Organization

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1. Introduction

The lack of a gender lens in environmental health programs, projects, and strategies globally reflects the historical exclusion of women,¹ which persists across health bodies, climate governance, and scientific institutions. Despite constituting the majority of healthcare staff [1], women continue to be underpaid, disadvantaged, and underrepresented in climate science [2] and furthermore, women from low-income-countries hold <1% of board seats across

¹ We use the term "women" inclusively to refer to all those self-defined as such, including trans women, as well as gender-diverse individuals.

Global Health institutions [3]. Achieving gender equity requires interdisciplinary solutions to protect those in vulnerable positions and balance interrelated systemic inequalities related to racism and ableism, amongst others [4].

1.1. Gendered impacts of climate change

Globally, climate change is undermining our health foundations; threatening our food, water and air, and our healthcare [5]. Environmental health threats range from high-level climate change-related effects, to low-level exposure to environmental pollutants. Yet, the heterogeneous distribution of social inequities and specific climate vulnerabilities results in vastly different impacts across regions, countries, and population groups [2]. Women living in Global South countries are disproportionately affected by climatic disasters and their health-related impacts, due to a combination of pre-existing socioeconomic inequalities, cultural norms and roles, and biological factors [6]. For example, in climate-related disasters, women are more exposed and may suffer disproportionate mortality rates in these events [7]; and those who do survive have shortened life expectancies [8], less access to financial assets that could be used for disaster preparedness and recovery [9], and represent 80% of those displaced [10]. Extreme climate phenomena (such as the *El Niño* Southern Oscillation) are forecasted to occur with increasing frequency and severity [11], disproportionately impacting women [12]. This grim scenario is worse for women who are impoverished, Indigenous, or who live in rural areas among other intrinsic vulnerability factors [13].

1.2. Gendered environmental threats

Air pollution has clear ramifications for women's health and that of their children. Previous studies have reported increased risks of infertility, preeclampsia, and gestational hypertension, as well as stillbirth, low birthweight, small-for-gestational-age, and preterm deliveries [14,15]. Indoor air pollution is a real health risk through the exposure to toxins related to biomass fuels burning (e.g., wood or animal dung) in unvented stoves and closed rooms. In Peru, 22.9% of the traditional stove user population for cooking or heating are women between 15 and 49 years [16]. Additionally, toxic chemicals found in water and soil can also cause significant reproductive health problems and adverse birth outcomes [17]. Concerning levels of heavy metals such as mercury, lead, cadmium, and arsenic are found in many Peruvian water sources used by Indigenous Peoples [18] and for those living near active mining, smelting, or industrial areas [19,20]. Pesticide exposure poses another environmental health threat in Peru, with high levels of food contamination and widespread pesticide poisoning [21].

1.3. Climate change and mental health: intersections with gender

Climate change serves to amplify pre-existing gender inequities and intertwines with other oppressive structures such as racism, homophobia, ableism, and classism. Women who are Indigenous, rural, younger, living in poverty, and of minority ethnic or uncertain migration status, experience greater environmental adversity and associated health impacts [22,23]. Environmental threats can also increase the risk of developing worse mental health [24,25], and even the chances of experiencing gender-based violence (GBV) [12]. Acute and chronic climatic exposures [26] such as heat, humidity, rainfall, droughts, wildfires, and floods are associated with detrimental mental health impacts (e.g., psychological distress) [22].

In many contexts, GBV increases in post-disaster settings (e.g., increased sexual assaults after floods [27] and increased violence against women immediately before, during, and after cyclones [28]). Disasters often drive migration and displacement where women bear

the worse brunt [12], risking physical assault and human trafficking. A recent global analysis of structural drivers for intimate partner violence (IPV) highlighted that colonialism and gender inequality are key drivers of GBV, and that in some patriarchal and postcolonial countries, like Peru [29], climate-related disasters and armed conflict often co-occur further driving up rates of GBV [30]. Climate-related disasters and armed conflict both result in the loss of property and assets, which increases household stress, which in turn increases IPV risk, potentially leading to increased substance use and mental health struggles [23,31].

1.4. Summary and study aims

Whilst interest in environmental health issues is growing, environmental exposure data from Latin America is lacking. This data is lacking despite the region experiencing remarkable anomalies in the last two decades, including heatwaves, droughts [32], and food insecurity and malnutrition, which are all expected to worsen with climatic stressors [33].

Between 2000 and 2019, Peru was among the top fifty countries most affected by weather-related events [34]. Peru provides an ideal case study to explore links between environmental threats and women's health. It is a country with great biodiversity and home to many different Indigenous groups [35]. It also has distinct climatic regions across its coastline, the Andes, and the Amazon – each with its own host of microclimates and environmental threats. In this complex context, our qualitative study aimed to understand the current Peruvian environment-gender-health nexus by exploring the extent to which a gender-sensitive approach is considered/prioritized across research, advocacy, and policy sectors and how transdisciplinary collaborations are perceived and formed across these key sectors.

2. Material and methods

2.1. Study design

Qualitative data was collected via remote semi-structured in-depth interviews with key informants from the public, academic, and advocacy sectors in Peru. We considered qualitative methods appropriate as they allow in-depth exploration of a topic, as witnessed, and interpreted by participants. Individual interviews explored perspectives and experiences of barriers/facilitators to implementing projects. A reflexive thematic analysis [36] was applied to gain a deeper understanding of challenges, collate recommendations for improving policy delivery, research, and advocacy agendas, and gather intersectoral reflections, based on the cumulative experiences of practitioners in these fields. We followed O'Connor's recommendations [37] for online interviewing due to COVID-19 travel restrictions imposed by both the United Kingdom and Peru.

2.2. Setting - Peruvian context

(See Supplementary File S1)

2.3. Sample and recruitment strategy

We used a combination of purposive and snowball sampling contacting representatives from the three sectors via email and telephone. We reviewed Peruvian government websites, and searched the main Peruvian university webpages; then collated a list of relevant non-governmental organizations (NGOs) working in the country by searching for "gender", "environment" and "health" in Spanish on Google; then we constructed a list of the most relevant Peruvian government ministries, academics focused on gender, environment, and/or health issues in the country, as well as national and international NGOs focused on tackling these same issues. We contacted

government ministers directly as well as their secretaries via telephone and email. Academics were contacted using the email addresses provided on their university profile pages. We used the generic contact information on NGO websites unless relevant individual email addresses were provided; we were then provided contact details of relevant persons to reach out to. For all three sectors, if we received no response after 5 days, we sent a follow up email and if there was still no response, we moved down the list of names to contact another relevant representative and repeated this process as necessary. Following the interviews, key informants were asked to recommend other suitable participants.

2.4. Data collection

We conducted eighteen qualitative semi-structured interviews that lasted 45–75 min in Spanish between July 14th, 2020, and March 16th, 2021. We (LB, EF, BT) developed the thematic topic guide collaboratively drawing from the research literature on gendered environmental health impacts. We included questions on defining environmental health, gender representation at work, perceptions of main environmental threats and most affected population groups, involvement in/awareness of relevant projects and collaborations (both within and between sectors), and barriers/facilitators to successful implementation. The topic guide allowed us to address key issues related to our research aims whilst allowing flexibility in the direction of conversation depending on the subjective perceptions and experiences of the participants, including their reflections on shortcomings and recommendations for improvements.

2.5. Data analysis

Each interview was discussed by the research team directly afterwards to promote critical reflection, and gain immediate insights into the content of data and assess thematic saturation (i.e. the point at which further interviews would be unlikely to reveal any new themes) and make necessary changes to the topic guide [38,39]. Recordings were transcribed using HappyScribe© software (HappyScribe Ltd, Ireland) and proofread by EF, LB, and BT whilst listening to the original audio files to check for accuracy. As all authors are native/fluent speakers, the original Spanish transcripts were used for analysis. We used a mix of deductive and inductive coding, assigning codes based on questions in the topic guide (See Supplementary File S2) and allowing codes related to new topics to emerge. Illustrative quotes were copied into a shared spreadsheet file and translated into English. The analytical process followed Braun and Clarke's six phases of thematic analysis [36]. EF and LB conducted the preliminary thematic analysis, and a full research team meeting was later held to achieve group consensus on key themes. We reflect on our position as UK-based researchers and how this might have affected our data collection process [40] in the positionality statement included as a Supplementary File S3.

2.6. Ethics

This study was approved by the Peruvian PRISMA Organización No Gubernamental ("Non-governmental Organization") ethics committee (approval reference: Carta CE0366.20). Participants were invited to take part in the research voluntarily. The purpose of the research and the interview process was clearly explained both in the written information sent to potential participants and verbally before beginning the interview. All participants gave their informed consent to participate and be audio-recorded verbally and/or in writing. Participants were informed that they could opt out at any point and that their personal data would not be used or reported. The interviews were confidentially stored on a password-protected drive accessible

only to the research team; data were anonymized, and a unique code was assigned to each participant.

3. Results

3.1. Sample characteristics

Only two of the eighteen interviewees were men. Participants were aged 31–61 years, and all were involved in programs related to the nexus of interest as managers, coordinators, unit heads, directors, or research leads. We met the target sample of six individuals from each sector, at which point we judged that data saturation had been reached for the aims of this study. Sample characteristics are presented in Table 1. Participant identifiers have been omitted for confidentiality, but their sector, role, gender, and age are provided. We have also included gender distribution and scope/aim for each institution to provide additional context. The principal themes are presented below, and detailed categories and codes (i.e., labels applied to the text to help organize the data into themes) are included as a Supplementary File S4. When quoting participants, the following identification codes are used: ACA (academic), NGO (non-governmental organization) and GOV (Public sector) followed by the interview number in each of the three groups.

3.2. Environment-health-gender nexus

3.2.1. Category: environment and health concepts

Following recent developments in the field [41], there is an ongoing broadening of the definition of environmental health, that lies between two perspectives: 1) an anthropocentric one, aiming to "better accommodate the knowledge and capacity to increase the longevity and wellbeing of humankind", traditionally associated with chemical, biological, or physical factors; and 2) a more recent scientific discourse acknowledging the importance of a systemic perspective, considering additional factors such as health disparities, social factors, and governance.

When asked to provide their own definitions of environmental health, the main factor mentioned by NGO interviewees was the need to live in *balance*, in line with Indigenous worldviews related to the environment, sustainability, and human health:

(NGO5) "...environmental health is...the tranquility, the well-being that we can have in our community [...] Indigenous Peoples and Indigenous women in particular talk about reciprocity. [...] that we need the mother earth, and she needs us, too".

The concepts that most academics and public sector participants referred to fell within the intersection of environmental hazards, human health, and relationships with other species:

(ACA2) "...the health of both the environment, that is, a condition of the well-being of the environment and ... also, of the living beings that are in it, right? Animal, plant, and human".

Two of the eighteen interviewees highlighted human rights, ecosystem protection, and the right to safe water, as well as the intrinsic links that this protection has with Indigenous Peoples:

(GOV6) "...its link to the human rights of environmental protection to improve the quality of life of people...to guarantee the existence of healthy and more sustainable ecosystems for the country, that is, I think, it is fundamental and more in a country like ours, right? It is culturally linked to protection and maybe to its very origin, right?".

3.2.2. Category: is gender a priority?

The NGOs we recruited were women-focused, which may explain why the majority described a female-biased gender distribution in

Table 1
Sample characteristics.

Participant				Organization			
ID	Gender	Age range	Role	Sector	Type	Aim/Scope	Gender distribution
ACA1	F	41–45	Researcher / PI	Academia / NGO consultancy	Research Unit at a Private university	Non-communicable diseases, Global health, Indigenous health	Among directors, the majority are male. Among Team members, the majority are female.
ACA2	F	41–45	Researcher / PI	Academia	Research Unit at a Private university	Indigenous Health, Global Health, One Health, Environment health	All her fieldworkers are males, her graduate students are all females
ACA3	F	41–45	Researcher / Assistant Professor	Academia	Research Unit at a Private university	Women's Health, Global Health, Public Health	All her fieldworkers are female, the staff at her Unit are half males and half females
ACA4	F	36–40	Unit Head / PI - Lead researcher	Academia	Research Unit at a Private university	Environmental Sciences, Epidemiology, Population Health	Most of her staff are female, her current graduate students (with scholarships) are males, her fieldworkers have gender balance
ACA5	F	41–45	Researcher	Academia	Research Unit at a Private university / Foreign University	Environment engineering, Biology, Chemical environment	Former Head/Supervisor were males, the environment research team are mostly female
ACA6	F	51–55	Unit Head / PI - Lead researcher / Assistant Professor	Academia	Research Unit at a Private university & Foreign University	Public Health, Environment health, Community Health	Large majority of team members are female
GOV1	F	31–35	Director	Public Sector	Ministry of Environment	Environment, Public Policy and Administration, Sustainable Development	Former Heads in that Ministry were female and staff as well
GOV2	M	36–40	Coordinator Research Unit	Public Sector	Ministry of Environment	Environment, Public Policy and Administration, Sustainable Development	Many team members are female
GOV3	F	61–65	Director Contamination control and chemicals	Public Sector	Ministry of Environment	Environment, Occupational Health, Environment Quality, Waste Management	Most heads in that Ministry were female and staff as well (she mentioned that in other Ministries e.g., energy and mining almost all Heads and staff were males)
GOV4	F	51–55	Director Environment quality	Public Sector	Ministry of Environment	Environment, Occupational Health, Environment Quality, Waste Management	Former Heads in that Ministry were female and staff as well
GOV5	M	46–50	Director	Public Sector	Ministry of Health	Physical and Mental health, Indigenous / Orinary Peoples Health	Large majority of team members are female
GOV6	F	41–45	Director-General / Lecturer	Public Sector	Ministry of Women and Vulnerable Populations	Gender, Social and Public Policy, Human Rights	Large majority of Directorial positions are female, however - there is a marked gender gap across other Ministries
NGO1	F	41–45	Program Manager	3rd sector	International NGO	Deliver humanitarian relief, development support and empowerment initiatives across vulnerable groups	Large majority of management and project coordinators are female
NGO2	F	31–35	Specialist/Researcher	3rd sector	International NGO	Sustainable development, environment management in the Amazon	2/3 of Directors are males, large majority of staff are females
NGO3	F	41–45	Program Coordinator	3rd sector	National NGO	Sexual and reproductive rights of women and teenagers	Majority of team members are female and LGTBIQ peoples
NGO4	F	61–65	Program Coordinator	3rd sector	National NGO	Rural development, economic empowerment, sustainable agriculture	Large majority of team members are female
NGO5	F	51–55	Director	3rd sector	National NGO	Build and strengthen capacities, and rights awareness for Indigenous groups	Large majority of team members are female
NGO6	F	56–60	Director	3rd sector	National NGO	Feminist political alliance focusing on sexual and reproductive health and rights	2/3 of Directors are females, large majority of coordinators and staff are female

their places of work. Given the patriarchal culture in Peru, female interviewees welcomed the opportunity to work in organizations led by women and alluded to other forms of diversity in their staff too:

(NGO1) "...We are in a very sexist country, where decisions are normally made by men... So having an organization where decisions can be made by a woman... gives many opportunities... to want to work here".

There were however still calls for greater involvement of women in the gender-environment-health arena, although interviewees acknowledged that this might not be enough to ensure meaningful change:

(ACA4) "I think that yes, it (gender) is considered a priority, but I don't know if we are achieving what we are supposed to [...] if it is effectively generating the desired impact... (...) I think everyone is trying to have more women (involved), they are, but I don't know if that's the way to do it".

3.3. Promoting and preventing intersectoral collaborations

Interviewees identified several structural barriers to collaboration, including patriarchal systems and fundamentalism, a lack of transdisciplinarity and intersectorality, and a lack of funding. Additionally, machismo made working with communities difficult:

(ACA3) "...With the Indigenous federations that we sometimes coordinate with, all the federations, the leaders are men. I don't know any women".

But living "in a country where there is still a strong presence and onslaught of conservative sectors" (NGO3) was also described to affect collaboration within organizations, and across sectors too. In particular, projects that involved topics related to women's empowerment, sexual and reproductive health, or minorities' rights experienced barriers either for obtaining approvals or furthering implementation at the local level.

In the academic sector specifically, nepotism, privilege, and toxic research culture were highlighted as key barriers. In addition, high staff turnover in the public sector constrained collaborative progress across all three sectors, as exemplified by these quotes from NGO and academic interviewees:

(NGO1) "...you have to do a lot of advocacy work to be able to move forward and generate changes ... and this is a job that you have to do permanently... [with] replacement of officials, each change of government, doing all the steps, advocating again ... that [causes] delays".

(ACA6) "...in the Ministry of Health, one group enters, another leaves... and a separate group enters and we need to start [a collaboration] from scratch... it also weakens the project a lot ...".

Some interviewees also identified aspects that helped collaboration, such as networking and having direct relationships built on reputation and trust, and also having transparency and accountability.

(ACA4) "Networking is super important, it is one of the critical things to be able to have, these collaborations are slow to achieve... but once you [get it], collaborating is not that difficult".

(GOV2) "Participation involves that we understand and know the people we are addressing, that we know their expectations [...] and be able to communicate in a trustworthy way, with transparent communication, right? Build your links to solve the problem".

3.4. Context complexity and vulnerability

Interviewees described a broad range of environmental issues and highlighted how these were context-specific across the different

geographies of Peru, such as illegal mining in the Amazon, freeze spells in the Andes, and flooding on the coast. Many mentioned the detrimental impacts of extractive industries, and climate change effects were another major concern:

(NGO4) "The climate is not like before, [now] it is crazy, it has changed, now it burns us more, now we feel more freezing, now it hits [us] more".

Water availability and contamination were also key concerns, as was COVID-19, but also broader external threats and contextual issues, such as corruption and abandonment by the government, which were already in place before the pandemic.

(NGO6) "Corruption... from the smallest (one), that for me has to do fundamentally with the lack of State, the lack of a notion of the State".

Across most interviews, research and work priorities were determined by previously set Global North funding calls or institutional agendas:

(ACA1) "Sometimes, [we as] researchers in middle-income countries, [have to] diversify the topics we do... due to the funding context of research... right? ... [...] who is setting the agenda? Or, who is proposing that x topic is something important, and how do they look at it from the North?... That seems to me, important ... to understand, right?".

Priorities were not always well-aligned across organizations. Only a small number of organizations, particularly those with a strong gender focus, prioritized a specific women's (environmental) health agenda, and many interviewees called for gender to be better incorporated into intersectoral projects:

(NGO2) "Environmental impact studies do not really address the social impacts [...] nor do they address the issue of women properly or the gender issue. [...] In projects there] is often a count of how many women are participating but there is not a measurement of the quality or opportunity of participation".

(GOV1) "...special attention should be paid to the issue of women, health and environmental health [...]".

With an organizational focus on women, most NGO interviewees mentioned women as being more vulnerable than men:

(NGO4) "Climate change is not a neutral phenomenon, it affects men and women differently, with women being the most affected... We all feel cold ... but the way it affects us, and in what conditions it finds us is very different".

However, NGOs differed in which groups of women they focused on (e.g., girls and teenagers, pregnant women, victims of violence or human trafficking, LGBTQI+ individuals). Indigenous populations were also identified by most interviewees across sectors as being particularly vulnerable. They highlighted that they live harsh realities, may be powerless, are overlooked, and susceptible to abuse:

(ACA6) "Indigenous groups are very vulnerable because they do not have a voice... they try to speak but nobody pays any attention, that is, [here] if you do not have money, [a well-known] name, surname, that is... you are nobody".

(ACA2) "You [need to] understand that you have rights [...], that you should not give up your land, or [know] what benefits you can have that will serve you from generation to generation[...] So for this, you

need to understand the language per se, but you also need to understand the system [...] it is a surprise that in Peru there are many, many great rights [policies], but they are not made effective... it's a system that's completely unfair, absent, invisible".

Whilst invisibilization was a key problem, women's empowerment was offered as an important solution for successful program delivery:

(GOV6) *"So I think what we're doing is important. I think we could continue to build larger spaces of economic networks for women, so those small entrepreneurs can continue to grow and articulate with different spaces...".*

(NGO4) *"We are... giving prominence to women, empowering women, they become their teachers. So, they are the ones who advise them [...] they have invited their partners, husbands, or children to the New Masculinities workshops, because it is also important to strengthen, sensitize this group in such a way that they help us to generate changes, equitable relationships".*

Although these empowerment initiatives are encouraging, the consensus amongst our interviewees was that a gender scope needs to be more thoroughly applied in environmental health projects which include climate change and health projects. A gender scope also needs to be applied in research-related projects, but also community processes like environmental certifications related to extractive industries. As one interviewee described, women's involvement is often tokenistic, and structural issues still needs to be solved.

(GOV6) *"...the highest number of director positions of the public administration, is represented by women, already. But...we're not on an equal footing in the country...In Peru women have a gender wage gap of 26.4% compared to our male peers [...] the number of women in the public administration has increased...additionally, women now achieve higher degrees of instruction, but they do not occupy (ruling) positions unlike our male peers".*

4. Discussion

Despite Peru's many environmental threats and vulnerability to climate change, our research has identified clear challenges to trans-disciplinary and intersectoral collaboration in addressing climate change and health issues, particularly as they relate to women. Our interviews with representatives from three key sectors (public, academic, and NGO) have highlighted that the successful implementation of gender-sensitive environmental health projects is impeded by various factors.

Firstly, definitions of environmental health varied across sectors. The definitional variance may go some way in explaining why interviewees were quick to put the blame and responsibility related to environmental threats and their consequences on other organizations and sectors. This tendency echoes previous research looking at the mental health consequences of *El Niño* flooding on the Peruvian Northern coast; everyone blamed everyone else without pointing out their responsibility for ameliorating these types of impacts [42].

Secondly, while a gender approach is essential for identifying differences in environmental exposures and experiences, we found that this approach was not adequately adopted across the three sectors. This has important ramifications and gender sensitivity needs to be increased to rectify imbalances, inequities, and injustices [43]. While some interviewees indicated that their organizations prioritized women in their projects, they were quick to mention the lack of a gender scope in other sectors. Encouraging, however, was the variety of different subgroups of women that projects focused on. This suggests a promising intersectional gender perspective, whereby groups

who are especially vulnerable, but also key to affecting change, such as Indigenous women, are prioritized in the delivery of some projects [44,45]. Still, many interviewees framed women's vulnerability in terms of maternal and reproductive health. Yet, women's health needs to be understood holistically, not only related to reproductive function. We urge future projects to think about addressing the environmental impacts on mental health and wellbeing too. A few interviewees highlighted projects which successfully centered on women's empowerment. Engaging perspectives of highly impacted but underrepresented groups - such as women - may contribute to reaching inclusive solutions for the climate crisis and promote environmental action, as has been highlighted elsewhere [46].

A possible limitation to the generalizability of the current findings was the gender of the respondents, as all but two participants included were women. This was interesting because across the three sectors, all the interviewees separately reported that "mostly women" were being trained and showed interest in working, doing advocacy, or research in the nexus. However, they also mentioned a deep gender gap and underrepresentation, as reported elsewhere [5,8,47]. Gender gaps and underrepresentation persisted across decision-makers, boards of directors, or those occupying the highest roles in research, or being awarded scholarships and mentorship opportunities in certain fields. This could not be further explored in this study, but future studies should include more men's perspectives, to better understand this issue.

There is good justification for ensuring women are involved in climate mitigation and adaptation strategies. Women tend to be more risk averse, risk perceptive, and risk vulnerable; are more likely to trust scientific information, receive official early warnings and peer warnings, and respond to emergency messages more seriously [48]. Women's participation in risk communication is argued to be essential because with more awareness, the better prepared they and their families will be [44,49]. However, as our interviews have highlighted, there are often gender-based inequities in intervention delivery. To prevent this, project meetings should provide childcare provisions or at least be timetable compatible [50]. Local women should also be put in positions of responsibility for delivering research projects and interventions as this will help improve women's agency and shift gender norms [50]. In some contexts, such as in rural and Indigenous communities with varying gender and cultural norms, it may be necessary to have women-only meetings to ensure they can participate [51]. Women-specific training across organizations can also be helpful to reinforce self-esteem and soft skills such as public-speaking [50]. Learning from and strengthening the land connections forged by Indigenous women, could improve women's and planetary health through reciprocal health-promoting relationships between women and the natural world [22]. Ideally, interventions should not just be gender sensitive but should try to be gender *transformative* [43]. This involves promoting gender equity by design, with, for example, facilitated discussions on social inequalities, and ways to address them. Working with young women may be particularly fruitful as this generation is especially worried and emotionally affected by the climate crisis [52], but also has the potential for great innovation and powerful collective action [53].

These are all important goals to strive for, but as highlighted by our interviewees, the patriarchal culture of broader society, as well as across the three sectors, and within target communities, acted as a barrier to meaningfully involving women in environmental health projects. In a country divided in many ways such as by its distinct climatic regions, and by a history of colonialism and continued structural violence through oppressive government regimes and persistent resource extraction [29], it is now more important than ever that organizations work together to address the myriad of environmental health threats facing the population, and women in particular. Additionally, other interrelated systemic issues, such as racism and structural discrimination against Indigenous Peoples, need to be

simultaneously targeted. This is no easy feat and requires complex multi-component interventions and multi-level transdisciplinary collaborations. As many of our interviewees alluded to, tackling environmental crises, and delivering effective climate mitigation and adaptation strategies requires not only a top-down approach but a bottom-up approach that centers communities in finding their own solutions. Lastly, women can't be treated as a homogenous group. Projects need to be context-specific, with empowering activities motivated by intersectional feminist ideals.

5. Conclusions

Our interviews highlight the multiple and inter-related contextual issues faced by environmentally threatened communities in Peru, and how macrostructural barriers contribute to a paucity of sustainable, gender-oriented, environmental health projects. Our findings elucidate only one part of a complex story. A desk review or policy analysis of publicly available documents from the three sectors, as well as community-based research that explores women's own perceived priorities and agency facing environmental hazards may help to provide a more comprehensive understanding and to explore participatory solutions. Engaging the voices, principles, and perspectives of underrepresented groups such as women, especially from Indigenous groups and underserved communities, may be necessary to increase environmental action and address gender inequity in the current climate crises.

Credit author statement

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Supplementary materials

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