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Article

Exploring Indigenous Climate Change Perceptions Through Tribal Talking Circles in the Colorado Plateau

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ABSTRACT

Marginalized communities, including Indigenous populations, experience climate change at a more extreme rate given where they live, despite their knowledge of and connection to the land. Due to this interconnection, there have been many negative impacts on cultural identities in correlation with climate change. For example, Indigenous communities that continue growing food, hunting and foraging on traditional lands now face increasingly limited resources due to changes in the land itself. To better understand Tribal experiences with our changing climate, this qualitative research study involved talking circles with Tribal members in the Colorado Plateau region of the United States. Specifically, our diverse research team aimed to identify and highlight Tribal perceptions of climate change, community, and education within the Colorado Plateau. This region, also known as the Four Corners, includes parts of Colorado, Utah, Arizona, and New Mexico. The land is home to many Tribes with regional ancestral ties, including, but not limited to, Hopi, Navajo (Diné), Havasupai, Hualapai, White Mountain Apache, Ute Mountain, Southern Ute, and Kaibab. We hosted four Tribal talking circles in this region to better understand Indigenous perspectives of climate change, local solutions, and lessons learned from collaborating with Indigenous communities. We partnered with the Nature Conservancy's Native American Tribes Upholding Restoration and Education (NATURE) program based out of Bears Ears National Monument to conduct this research. Results were used to guide curriculum development for the NATURE program and can provide invaluable insight for those wishing to collaborate with Tribal members on climate resilience.

KEYWORDS: trust; privacy; government; Indigenous knowledge; cultural humility; climate resilience; water; community, service

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INTRODUCTION

Indigenous perspectives on climate change, often influenced by a profound connection to nature and traditional knowledge, underscore interconnected environmental and social ramifications [1]. In many Indigenous worldviews, climate change is perceived within a larger context of interdependent issues such as land degradation, loss of biodiversity, and social inequities [2]. Traditional Ecological Knowledge (TEK), developed over millennia, remains essential for adaptation, though its preservation faces challenges amid ongoing environmental and social pressures [3].

The recognition of Indigenous sovereignty and self-determination is viewed by many as paramount in climate change research and policy, necessitating a more equitable response than what has traditionally and is still often seen in the American southwest [4]. Incorporating spiritual beliefs, religious freedom, self-determination, and preservation of sacred sites into Indigenous program planning are examples of ways to increase Indigenous sovereignty [5]. Although the federal government and academic institutions are increasingly acknowledging the importance of collaborating with Tribes, there remain many "underlying institutional dynamics rooted in colonialism and structural racism that constrain organizations from meaningful and equitable collaboration" ([4], p. 27). This intertwining of colonialism and Indigenous environmental justice highlights the necessity for systemic transformation, with Indigenous peoples leading Colonial societies in fostering more sustainable and just systems [6,7].

Climate Change

The National Climate Assessment report published in 2014 [8] demonstrates that climate change is already significantly impacting various sectors of the US economy and these impacts are predicted to increase. In the literature, major sectors in the Southwest US region predicted to be impacted include:

- Agriculture: Expectations include more severe weather events, leading to reduced crop yields and increased food prices. Pest and disease pressures are also anticipated to rise [9].
- Water Resources: Changes in precipitation patterns and higher evaporation rates due to rising temperatures will impact water availability, causing shortages, reduced quality, and increased competition [10].
- Energy: Temperature and precipitation changes will affect demand and the availability and cost of resources like natural gas and hydropower. Rising temperatures may decrease power plant efficiency [11].
- Transportation: Increased flooding and extreme heat will disrupt infrastructure, leading to system disruptions and higher maintenance costs [12].

- Human Health: More severe weather events and changes in air quality will cause health issues like heat-related illnesses and the spread of diseases [13].
- Forests: Climate change effects such as wildfires and insect infestations will alter ecosystems, leading to changes in species composition and habitat loss [14].
- Ecosystems: Climate change will affect ecosystem services such as water purification and pollination, as well as the distribution and abundance of plant and animal species [15].

It is unknown, however, whether these major areas are perceived as having equally high importance to Indigenous peoples living in the Southwest region of the US. This research study contributes to better understanding the major areas of importance when considering climate change to a sample of Indigenous peoples living in the Colorado Plateau.

Garfin et al. [16] highlight the Southwest region of the US, including states like Arizona, Colorado, and New Mexico, as already experiencing severe climate change effects including rising temperatures, dwindling snowpack, reduced streamflow, and intensified droughts and wildfires. However, according to research on the unique challenges facing southwestern Tribes, "few scientific studies address and quantify current climate change impacts on Native lands and peoples of the United States, except in Alaska" ([17], p. 389). Trends are projected to worsen and impact ecosystems, water resources, and human systems such as agriculture and public health. The Fourth National Climate Assessment emphasizes the need for both adaptation and mitigation strategies in response [8]. Adaptation involves adjusting to current and future impacts, while mitigation aims to limit greenhouse gas emissions [8].

Indigenous communities employ TEK to adapt to climate change, sometimes integrated with Western science [18]. Resilience activities include examples such as wetland restoration, community relocation, and infrastructure modification [8]. Renewable energy development, particularly solar and wind power, is a mitigation strategy pursued on Indigenous lands [18]. Sustainable agriculture and transportation practices also contribute to reducing carbon footprints [18].

However, the Fourth National Climate Assessment indicates insufficient efforts globally for meaningful mitigation [8]. Given that many Indigenous communities have minimal greenhouse gas contributions, responsibility for impactful mitigation should primarily rest on those most accountable. Collaboration among government agencies, Tribal nations, and local communities is crucial in the Southwest US and beyond [16]. Vulnerable populations, including low-income and Tribal communities, face heightened risks like heat waves and water scarcity [16]. Recommended adaptation strategies for the Southwest US include water efficiency improvements, better water management, emissions reductions, and fostering resilient communities, which should be pursued with Tribal input into priorities and preferences [16]. Policymaking focused on

emissions reductions can mitigate climate change impacts and safeguard vulnerable populations within the Southwest US region [16].

Environmental Issues in The Colorado Plateau Region

Indigenous communities in the Colorado Plateau region face various environmental justice issues, including impacts from oil and gas drilling and uranium mining [1,19]. These activities disrupt subsistence practices and cultural traditions, endangering health, waterways and wildlife. Access to water resources, notably the Colorado River, is limited to Tribal nations due to heavy damming and diversion, neglecting traditional water rights. Uranium mining's legacy includes contamination and health risks, prompting cleanup efforts and opposition to further mining. Currently, ongoing impacts of settler colonialism persist, such as land displacement, assimilation, economic marginalization, and cultural erasure, affecting Indigenous communities not just in the Colorado Plateau region, but worldwide [2]. Addressing these challenges necessitates prioritizing Indigenous sovereignty, self-determination and recognizing their profound connection to the natural world.

In a systematic literature review of methods for inclusive approaches to identifying priorities and strategies for climate adaptation, the importance of considering the local context and shared governance with a range of knowledge holders over decision-making and action are highlighted [20]. A framework for this approach includes (1) inclusive identification of the causes of climate change; (2) inclusive identification of the effects of climate change; (3) inclusive goals and processes of climate change adaptation; and (4) inclusive evaluation of climate change adaptation efforts [20]. To support inclusive climate action in the Colorado Plateau, this study explores how Indigenous communities in the Colorado Plateau region perceive climate change and demonstrate climate resilience.

MATERIALS AND METHODS

Our research team partnered with Tribal members from the Navajo Nation and Hopi Tribe to explore their personal experiences with climate change, identify perceived primary factors contributing to it, and perceived ways to increase climate resilience [21]. The Navajo Nation encompasses land within Arizona, New Mexico, and Utah, and is home to over 300,000 members, whereas the Hopi Tribe resides primarily in northeastern Arizona and includes over 7000 members living in 12 villages on three mesas.

Our project was guided by the following research question: "How do Indigenous communities in the Colorado Plateau region understand climate change and examples of climate resilience?" [21]. We collaborated with the Native American Tribes Upholding Restoration and Education (NATURE) program at Dugout Ranch in Bears Ears National Monument and sought guidance from specific Navajo Nation Utah Chapters to ensure

that we approached the project, the research question, and the target population appropriately. NATURE is a seven-week program offered to Tribal members which culminates in a capstone project, centralized around natural resource management and climate resilience. The program is taught by a mixture of Tribal and non-Tribal professionals.

In discovering Tribal perspectives on climate, community and education through a qualitative research approach, we aimed to strengthen the NATURE program as a whole alongside its climate change content by adding more cultural relevance. This aim stemmed from interactions with the NATURE program staff, where our team was requested to provide insights that would improve the NATURE program and increase its cultural relevancy. As an initial step in exploring Tribal perceptions on these topics, we attended community events and public spaces such as an earth day cleanup event with the Red Mesa Chapter and volunteering at the Red Sands Powwow to become more approachable and known. Our goal was to first immerse ourselves in the community, display our dedication, and foster relationships.

Taking a qualitative approach when working with marginalized communities is beneficial to for several reasons:

1. Inclusivity: Through open-ended questions, qualitative methods allow participants to express themselves in their own words, rather than being limited to predefined categories or options which are less culturally appropriate for Indigenous peoples [22].
2. Contextualization: Qualitative research allows for a deeper understanding of the context in which marginalized communities exist. This includes cultural, historical, and social factors that may influence their experiences and perspectives. Understanding these contextual factors is important for creating interventions and policies that are culturally appropriate and relevant [23].
3. Empowerment: Qualitative research can empower marginalized communities by giving them a voice and an opportunity to shape the research process. This can help to counteract the power imbalances that often exist between researchers and marginalized communities [23].
4. Complexity: Qualitative research is well-suited for exploring complex social phenomena including ‘wicked’ problems and understanding the nuances of individuals’ experiences. Marginalized communities often face multiple intersecting forms of oppression and discrimination, and a qualitative approach can help to capture the complexity of these experiences [24].
5. Trust: Qualitative research can help to build trust between researchers and marginalized communities. By actively listening to their perspectives and experiences with a commitment to understanding and addressing community needs and concerns, researchers establish a more collaborative and equitable research relationship [25].

A phenomenological theoretical framework was applied for the purpose of representing and understanding different perspectives on climate change. Phenomenology is a theoretical approach to qualitative research that seeks to understand how people make sense of their lived experiences [26]. At its core, phenomenology explores and describes how people experience the world around them, uncovering the meanings that people attribute to their experiences and how they make sense of them [27]. Phenomenology is a useful approach or understanding complex social phenomena such as the experiences of marginalized or stigmatized populations, and it can help to provide insights into how people navigate and make meaning of their experiences [26]. According to Bernette et al. in their research with Indigenous communities, "a benefit of using a phenomenological method is that it enabled researchers to capture underlying essences while maintaining the individual stories and perspectives" ([28], p. 291). Struthers notes the suitability in phenomenology as a research framework for Indigenous peoples in that it "adds fluidity and flexibility to the research process and utilizes the art of traditional storytelling" and the researcher and research participants are viewed as coresearchers ([29], p. 130). This approach also involves a focus on the description of lived experiences, rather than attempting to explain or interpret them [27]. It often involves interviews or other forms of qualitative data collection that allow participants to describe their experiences in their own words [26]. Researchers who use this approach seek to identify patterns and themes that emerge from the data, as well as any contradictions or inconsistencies [26]. Given its suitability in capturing underlying phenomena while maintaining individual voices and stories with Indigenous peoples, phenomenology was identified as the best framework for answering our research question.

Cultural Humility Framework

Cultural humility is a framework for qualitative research that emphasizes the importance of self-reflection, critical awareness, and sensitivity to the cultural context in which research takes place [30]. It is often used in research involving marginalized or oppressed populations, as a way of promoting ethical and respectful research practices [30]. These concepts are highly consistent with notions of epistemic justice [31,32], which addresses an appreciation of the value of knowledge systems aside from Western science and knowledge holders other than scientists. We selected this framework because cultural humility enables researchers to approach their work with a sense of humility and openness, recognizing that their own cultural biases and assumptions may influence the research process and the interpretation of findings. It involves acknowledging the power dynamics that exist between the researcher and the research participants, and actively working to mitigate these power imbalances.

The cultural humility framework asks researchers to engage in ongoing self-reflection and critical awareness of their own cultural identity, biases,

and assumptions [30]. It also emphasizes the importance of building trust and rapport with research participants and engaging in a collaborative and respectful research process. In practice, the cultural humility framework involves taking the following steps that our research team adhered to:

- Engaging in ongoing critical reflection on one's own cultural identity and biases (achieved through core members of our team writing subjectivity statements and engaging in ongoing dialogue around this topic with our advisory board).
- Being open and responsive to feedback from research participants (for example, sending results summaries within a week of data collection, and encouraging feedback from participants on our interpretation of the conversations).
- Engaging in active listening and valuing the perspectives and experiences of research participants (using a semi-structured talking circle guide and allowing longer periods of time for participants to contemplate and respond).
- Building trust and rapport with research participants through respectful and ethical research practices (vetting our interview guide with Indigenous and Euro-American consultants and conducting research in culturally appropriate settings such as Powwows and Hogans).
- Recognizing and working to mitigate power imbalances between the researcher and the research participants (examples include sitting alongside participants and actively acknowledging limitations of the Western-centric lens of some members of our research team).
- Being sensitive to the cultural context in which research takes place and adapting research methods and practices accordingly (significantly extending the length of time for our study in order to provide more time for building trust) [30].

These steps proved very helpful in guiding the research, especially when working with communities with different cultural backgrounds. The cultural humility framework provided a way for our team to promote ethical and respectful research practices that prioritize the voices and experiences of our participants, while also helping to mitigate the power imbalances that can exist between researchers and research participants.

Positionality

As white female academics raised in Western society serving as the two study leads and primary authors, we acknowledge our positionality and the specific challenges it presents in working with Indigenous communities. Historically, academics have appropriated Indigenous knowledge without proper credit or consent (commonly known as "data extraction"), which is compounded by the legacy of colonization and violence inflicted by Western settlers. Given these issues, we prioritized

building relationships before conducting interviews and discussions. Because of the traumatic history, we adapted our language and approach to be culturally sensitive, for example in using “talking circles” instead of “focus groups”, which was well-received by colleagues and community members. We also had third parties review and suggest ways to decolonize our interview guide. Collaborating with the NATURE program, we crafted questions respecting each Tribe’s uniqueness without generalizations. We aimed for language promoting equality and inclusivity, avoiding hierarchical or disparaging terms. One example of this from our question bank includes “The Western, white-centered, climate movement often leaves out voices that are most impacted in terms of the climate crisis. What do you wish more people knew about the ideas and practices of Indigenous environmental stewardship and the unique climate challenges that Native communities face?”.

Decolonizing language includes recognizing its power to shape perceptions and to potentially reinforce oppressive systems like colonialism and imperialism [24]. Terms like “stakeholder” may reinforce Western-centric views, erasing Indigenous perspectives and voices [33]. Our project included an advisory council deeply engaged in work with Tribal communities as well as an Indigenous program coordinator who helped us decolonize our semi-structured talking circle guide and the language in our reporting of data back to Tribal members.

Ultimately, essential steps for Euro-Americans collaborating with Indigenous communities on climate change include understanding both systemic issues like capitalism and settler colonialism, which drive environmental destruction, and settler colonialism’s ongoing contribution to Indigenous injustice [7,34]. Collaboration must prioritize Indigenous leadership and self-determination, rather than exploiting their knowledge and labor to mitigate problems caused by non-Indigenous groups. Norgaard [35] highlights one example of the interconnectedness of food, cultural identity, and the environment as a way to challenge Western compartmentalization and Cartesian worldviews.

Following decolonization of our semi-structured talking circle guide and approval from Utah State University’s (USU) Institutional Review Board (IRB), our data collection included four talking circles, each around one-hour in length, including:

- Two talking circles with the NATURE participants; one at the beginning and one at the end of the program (each with 6 participants).
- One talking circle with organizational partners; including both representatives from Women of Bears Ears and the Rural Utah Project (3 participants).
- One community talking circle during the Red Canyon Powwow (6 participants).

This process provided a strong foundation for drawing meaningful research conclusions, as the methods we employed were integral to the

overall study. The results section presents a substantial number of code applications as the time we invested in preparation likely fostered more honest, in-depth conversations and authentic responses.

Talking Circles

Talking circles offer a space for participants to engage in group discussions, with researchers primarily listening. This format yields detailed data, facilitating a deeper understanding of the topic [36]. It fosters interaction among participants, uncovering new perspectives and insights not always evident in individual interviews [37]. Talking circles excel in capturing diverse perspectives, identifying common themes, and exploring variations in experiences [37]. They provide context and depth by allowing participants to elaborate on their views, clarifying complex issues [37]. Particularly effective for sensitive topics, they offer additional insights and understanding in a group setting [37].

We conducted our talking circles in locations comfortable for participants in a mix of in-person and online formats which included the NATURE site in Bears Ears, a Navajo hogan, the Red Sands Powwow, and on Zoom. For the in-person talking circles, participants and facilitators were seated in a circle, and for Zoom, participants were not asked to turn on their camera. Each talking circle included an Indigenous and Euro-American facilitator team to ensure deep collaboration, trust, adherence to our decolonized talking circle guide, and that each voice in the talking circle was heard; see the Appendix for an example of questions included in the talking circle guide [21]. All participants shared their perspective at least once in each talking circle.

Transcribing and Coding

Otter Ai is a transcription and voice recording software that is designed to make qualitative research more efficient and accurate [38]. One of its key features is its ability to transcribe audio recordings in real-time, saving researchers a significant amount of time that would otherwise be spent transcribing manually. This time savings allows researchers to focus more on the analysis and interpretation of the data. As the research team cleaned the transcriptions, patterns and themes began to emerge alongside a better understanding of commonalities in perspectives shared by the individuals and participants.

Coding involved dissecting data into smaller units and assigning descriptive labels or codes (see Appendix). These codes helped identify patterns, themes, and relationships within the data, revealing key insights [39]. Coding offers a systematic approach to manage large amounts of data, ensuring accuracy and consistency in analysis [39]. By employing a systematic coding scheme, researchers maintain reliability and reduce subjective interpretation or bias. Moreover, coding enhances transparency and rigor in qualitative research by documenting the coding

process and rationale behind each code, and enabling others to assess the validity of findings [39].

In this study, Dedoose, a web-based software, was utilized for coding and analysis, offering features that streamline qualitative data analysis [40]. The co-occurrence tool was a key analytical tool utilized in this research as part of the coding process. Co-occurrence refers to the frequent appearance of two or more categories or codes together in the same data set. Individual and co-occurring codes were then translated into major themes with supporting quotes to tell the story of Tribal perspectives on climate, community, and education.

Collaboration Process

Throughout the project, we consulted Indigenous individuals for guidance on culturally sensitive approaches. Their insights emphasized persistence in contacting potential participants and the importance of decolonizing processes. We used personalized and thoughtfully spaced email, calls, and texts to demonstrate commitment while balancing a respect for their time.

In engaging within the Navajo Nation, we faced challenges in obtaining approval from the Navajo Nation IRB. Despite multiple attempts, we received no response, which lead to delays and complications with USU's IRB. Our Diné partners suggested no news indicated no opposition from the Navajo Nation IRB, but this lack of confirmation caused significant timeline delays and changes in our reach.

During the IRB process, we worked closely with the Nature Conservancy's NATURE program to determine talking circle dates, locations, and any editorial suggestions to the interview guide. In our communication with the NATURE program leads, we prioritized transparency about our intentions, questions, and plans for publishing the results. Providing all necessary documents, including consent forms and our National Science Foundation-funded grant narrative and budget ensured transparency.

Our initial talking circles were with the Canyonlands Research Center's NATURE program staff and participants. These engagements provided insights into the program's co-creation process, community perceptions, and effective communication methods. We then conducted a talking circle at the 2022 Red Mesa Powwow with a handful of community members providing depth insights into the connections between capitalism and climate change. Our third talking circle was with members of the Rural Utah Project and Women of Bears Ears where participants discussed issues of exploitation of Indigenous lands and the importance of education in uplifting Indigenous populations. A final talking circle with NATURE participants provided valuable feedback on program practices and climate-related topics.

To minimize bias, we developed a system for documenting takeaways from each talking circle. Sharing brief (2-page) major takeaway reports

with participants within a week of the talking circles, encouraged by our advisory council, fostered open communication and transparency. Additionally, we maintained contact with program alumni to keep them informed about project opportunities and ensure continued engagement.

RESULTS

The analysis yielded valuable insights into Indigenous perspectives on climate change, highlighting their views on its causes and strategies for enhancing resilience in the most affected communities. The Appendix includes an overview of the key question themes and examples to contextualize the research discussions This contextual background established a foundation for the subsequent analysis and interpretation of the results.

Code Applications and Descriptors

During the qualitative coding process, 36 codes were generated, which included 5 “parent” or main codes, resulting in a total of 478 code applications. To keep track of each media transcript, our team assigned a descriptor to indicate which participant group was involved. The four descriptors used were (1) NATURE Program Participants, (2) NATURE Program Staff, (3) Organizational, and (4) Community. These descriptors helped our team to organize and analyze the data more efficiently through Dedoose.

The code chart for this research (see Appendix) highlights the climate change and community topics discussed in the talking circles and provided valuable insights into the main topics that emerged. The code, its description, and the frequency of its application all helped guide development of our final themes.

While we expected to see certain topics in our coding process, we also noted many unexpected findings. The codes that were applied the most, with 15 or more mentions, included knowledge sharing, capitalism, human health, environmental justice, environmental education, development, caretakers of the earth, lack of access to financial and natural resources, pollution, exploitation, community, agriculture, public service, and cultural practices. However, some of the codes mentioned more frequently were influenced by factors such as the questions we asked, the group we spoke to, or the timing of the project. For example, our conversations took place soon after the major COVID shutdowns, so human health was likely discussed more frequently than it would have been if the discussions occurred before the pandemic. Another example is public service, which emerged as a significant theme when discussing the hardships brought on by the COVID-19 pandemic. The following themes emerged from major topics identified in the code book, verified by the research team and select participants, and are organized by theme title, support quotes, and researcher elaborations.

Government Mistrust: Exploitation of Indigenous Land and Resources

In the discussions surrounding the interconnectedness of environmental and social issues, participants shed light on the detrimental impact of the exploitation of Indigenous land and resources, which fosters a relationship of mistrust between Indigenous populations and the government. This exploitation was correlated with environmental injustices and pollution, with significant implications for human health. This sentiment reflects the profound consequences of environmental degradation, particularly concerning the quality of water and soil vital to Indigenous communities. As many participants mentioned,

"The different resources, especially monetary-wise (...) we have absolutely no economic base here on the reservation. Any type of economy that we see was usually through just trade and barter. But now it has a price on it because of inflation and everything that's happening through climate change. It has made it harder for people to just be able to be a community anymore and just have that exchange happen between families and between neighbors. So, we really don't have any type of resources in the sense that we can come up with a lot of these different programs to help our communities where climate change is a concern or economic development is a concern. We must look at different organizations who are willing to provide some of these monetary resources" (participant 5).

"It affects our crops, it affects our lifestyle. This is our food, this is how we survive because we don't have stores that are right next door; Walmart's that are 20 minutes away. Some people must travel hours. We rely on making sure our cattle, our sheep, all those animals our crops survive in the season. Because at the end of our crop season, that's what's going to make us get through winter. And our crops don't grow like that, we are stuck halfway through winter, starving. Got to go to the city, go get food and pay those prices, and then processed food gets us sick, because we're so used to our foods on our land, with no process[ing], no pesticides, no extra sugars, no salt" (participant 15).

"I wish that a long, long time ago they didn't find that uranium. Up above the hill, and from my understanding, the uranium is in the water table now. Deep, deep into the water table. The most pristine water that you can ever find on the face of the earth, it's getting in there. That's the water that we drink (...) Those water tables are the main water tables that are going to affect my community" (participant 17).

"You know, I noticed this year that there has been a lack of bees. So that pollination between—whether it's dry farming, or there's irrigated farming, any of that—the lack of bees has really impacted growth, whether within the city or out in rural areas. That's another thing that would really help with a lot of these farmers because a lot of them, they'll grow things, but they don't produce anything from it" (participant 6).

In these sample quotes, we see examples of ways Indigenous peoples perceive climate change (i.e., that it is tied to extraction and impacting human health), are building climate resilience (i.e., growing their own livestock and crops), and can further build resilience (i.e., increasing native bee habitat and health, shifting away from monetary exchange back to a primary focus on trade and barter, and looking to organizations to provide funding for programs).

Cultural Preservation and Knowledge Sharing

Cultural preservation and knowledge sharing emerged as another major theme, with participants expressing a pressing need to safeguard Indigenous languages, traditional medicine, and ancestral songs. This expressed need underscores the urgency of preserving cultural heritage to ensure its transmission to future generations. Privacy concerns were also raised regarding the protection of cultural knowledge, underscoring the need to respect and safeguard Indigenous traditions and practices. Although these concepts are well documented in research with Indigenous peoples [1,6,35], the following insights provide a specific lens on the loss of traditional knowledge due to colonization as it relates for these groups, in particular.

"Preservation of language, preservation of knowledge of medicine that is not considered pharmaceutical, preservation of songs. There are a lot of songs that only certain elders know now that a lot of people never learned that they can't pass on anymore" (participant 15).

"How much more do we have to give up for people to realize that this is our lives, we want to keep as much of it intact and within ourselves within the communities and not be exposed to everyone else" (participant 5).

"I think a lot of it isn't climate right now. It's trying to preserve our way of life. We're trying to stay alive, and at the same time, we're trying to express that us trying to stay alive comes from the results of our surroundings, our environment. But we need to stay alive. We've got to figure out how we're going to still plant crops every year, how we're going to keep our livestock alive" (participant 15).

These excerpts provide insights into the delicate balance between surviving with limited access to resources, preserving culture and Tribal resilience through intergenerational knowledge sharing, and keeping cultural traditions protected from external exploitation and use.

Public Service

Conversations surrounding community resilience and empowerment underscored the strength of Indigenous communities in the face of adversity. Throughout the discussions, the theme of public service emerged prominently, with NATURE participants actively participating in activities such as food banks and trash clean-ups, demonstrating a commitment to fostering community resilience. Moreover, agriculture,

community-building, and the education of future generations were identified as crucial pillars contributing to community empowerment and resilience. Participants emphasized the value of alternative systems not grounded in capitalism, expressing deep concern about the degradation of their land due to harmful practices.

"We're constantly adapting. We're constantly fighting. We're constantly defending. We're constantly educating. We're constantly trying to put the awareness out there, but there's only a small percentage that supports us and try to defend us" (participant 6).

This emphasis on community resilience highlights the pivotal role of Indigenous-led initiatives in addressing environmental and social challenges. Although climate change impacts various aspects of their lives, it may not currently be their primary concern. This sentiment is reflected in our data, as discussions of climate change did not arise as frequently as other topics indirectly affected by it.

Western Colonial-Based Systems

Discussions also underscored a critique of Western systems and advocacy for alternative approaches. Participants highlighted a generational divide in attitudes towards accepting help from the Western world, with younger generations desiring alternative approaches while elders were perceived as more hesitant to embrace change. Despite this divide in perspective, participants stressed the need across-the-board to prioritize Indigenous voices and leadership in creating lasting change that benefits both people and the planet. Reflecting on the impacts of colonization and mistrust of Western-based approaches by elders, one participant remarked,

"It's really hard for me to explain because a lot of the people within my community, the people that I've built a rapport with, the response that I get from them is 'Why do you feel like you need to get the non-Indigenous involved? Why can't we do this on our own? Why can't we reimplement a lot of the teachings in the culture, and then bring that together and see what we can do with our teaching and implement it into the Western colonial's education system?' Whether that's trade school, whether that's learning about science and how that applies, how Navajo apply science to everything that they do and how science is identified here and in the non-native side of things" (participant 5).

These findings shed light on potential barriers and opportunities in engaging with Tribal members around climate change adaptation, mitigation, and resilience from Western science. Indigenous people apply their own science and cultural approaches to climate change issues, and there is opportunity to see with both worldviews and move forward in ways that apply this 'two-eyed' seeing.

Ties Between Community and Public Service, alongside Environmental Injustice and Capitalism

Several significant co-occurrences emerged in our analysis, including the close relationship between community and public service. This finding reinforces the idea that public service plays a central role in the formation and strengthening of Indigenous communities. Another key co-occurrence was the pairing of environmental injustice with capitalism, which highlights the perceived role of capitalism in driving environmental degradation and extraction, often leaving Indigenous communities to bear the burden of pollution and its associated health impacts. Similarly, the close link between environmental injustice and pollution is further evidence of the harmful impacts of oppressive systems on Indigenous populations. Additionally, the frequent co-occurrence of colonization and exploitation underscores the ways in which oppressive systems lead to the exploitation of both people and the environment in affected regions. Finally, the frequent pairing of agriculture and water is unsurprising given the centrality of agriculture to many Indigenous communities' economic base.

"Testing the soil so we're not being in a place that radiates or has no good minerals for us to plant. Water, making sure our water is safe, that we can get it for our livestock to keep them alive. Being able to use the science to basically test our areas, so we're not getting sick anymore" (participant 15).

"I want everybody to say this with me: 'colonialism causes climate change', okay? Say it with me: colonialism causes climate change. When you have an economy that's built on extraction, more and more capitalism. 'I need more stuff. Bigger is better'. If there's not an opportunity to make profit, they don't want to do it. As Indigenous people, we don't really look at things like that. That was a very non-Indigenous settlers' mentality. Now the settlers that came here, that was their way of doing business. They came here, killed a lot of people, raped the land, and it's been continuing for the last 500 years of occupation. We have to change the way we think of things. We have to not only include Indigenous people, but they need to be leading the charge. There needs to be a change, a shift in power. It's hard for people who are settlers to realize that because they've been driving the car for the last three to four hundred years. But it's funny, because in the last 300 or 400 years, we're in a climate change crisis right now" (participant 18).

"Once we were colonized, you know, everything from there on has been adapting to progress" (participant 6).

"It makes me not want to participate in [research] spaces like this. But I feel like spaces like this are important. Hopefully, people here can unplug their capitalist mindsets and hear my voice. What we need to understand is that in these spaces, it's the Indigenous people who have the wisdom. Don't ever give up that wisdom without being compensated because that's bullshit. That's enough" (participant 18).

Participant perceptions of the connection between colonialism, capitalism, insatiable consumption and climate change relates to calls for economic degrowth and similar alternative economic systems that are developed using a more integrated lens.

DISCUSSION

This section focuses on the methods used to engage with Indigenous communities and how they shaped our findings. The intersection of climate issues with colonialism and capitalism was revealed through the use of talking circles, alongside a deep respect for nature, the preservation of Indigenous cultures, and the need to address mental health and political representation. The talking circles also highlighted communication barriers, government involvement, and environmental justice issues, such as land overgrazing and water contamination. These findings suggest a critical need for greater Indigenous voices in articulating challenges and opportunities within their communities.

Our research not only captures these sentiments but also underscores the value of the methods employed to reveal them. By fostering long-term, authentic relationships, we were able to engage in candid and clear conversations that can serve as a foundation for co-creating initiatives centered on Indigenous climate resilience at both the community and broader societal levels.

Engaging Indigenous facilitators proved essential in building trust and cultural understanding. These facilitators acted as cultural liaisons, ensuring that communication between researchers and community members was effective and respectful. They brought an intimate understanding of their community's values and beliefs, which helped us navigate cultural protocols and conduct research in a culturally sensitive manner. This approach promotes community ownership, trust, and mutual respect, ensuring that the research is both relevant and applicable.

Consulting with Indigenous Chapters, such as the Red Mesa Chapter on the Navajo Nation, provided critical insights into cultural protocols and expectations, ensuring that the research process was appropriate and respectful. Transparent communication throughout the research process helped build trust, enabling the community to make informed decisions and provide valuable feedback. Sharing results in a timely manner further demonstrated respect for Indigenous knowledge systems, reinforcing accountability and trust.

Rather than creating new programs, we collaborated with existing Indigenous initiatives, like the NATURE program. This approach supported community needs and avoided competition, ultimately strengthening our partnership and aligning our work with community priorities. We also recognized that flexibility in timelines and budgets is crucial when working with Indigenous communities, as relationship-building and cultural practices often take precedence over rigid schedules. Persistence and respect for boundaries are essential in this process.

The talking circles themselves were a key method, with extended time and silence allowing participants to reflect and share their experiences in a way that honored Indigenous oral traditions. Facilitators from the community helped encourage open conversation and genuine perspectives. Building a support network of those engaged with Tribal communities fostered collaboration and mutual support, while also acknowledging the weight of historical injustices.

Indigenous peoples have stewarded ancestral knowledge for millennia, and their data, or "Indigidata", is a valuable form of currency and power [41]. This data includes knowledge about the environment, lands, resources, and cultural histories. Ensuring Tribal consent and data sovereignty is essential to fostering equity and trust in the research process, and it is critical that any data collected benefits the Tribes directly, preventing further exploitation [41].

While we shared summaries of our findings with participants for feedback, we did not share raw data at the time, unaware that Utah State University's IRB supports not only the sharing of raw data (with identifiers removed) but also Tribal ownership of data collected from Indigenous peoples. Moving forward, we will adopt this practice and approach all future research with a lens of cultural humility, which fosters trust, respect, and open communication. This mindset acknowledges our status as outsiders and prioritizes listening and learning from Indigenous communities, centering their voices and perspectives throughout the research process.

Limitations and Implications for Further Research

Although this study provides depth insights into climate change perceptions of a sample of Indigenous peoples living within the Colorado Plateau region, the region is home to hundreds of thousands of Indigenous peoples and the findings are in no way representative of all perspectives or necessarily even mainstream Indigenous perspectives of the region. Our research was also limited by grant timelines and extreme weather (hail, rain, wind, and cold temperatures) during our community talking circle, both of which resulted in a lower number of talking circles and participants than we had originally hoped.

Future collaborative research with Indigenous and Euro-American collaborative teams with elder and Chapter approval, alongside Tribal IRB approval can delve deeper into various perceptions of climate change and into on-the-ground examples of climate resilience practiced by Indigenous communities in and around the Colorado Plateau. From our findings, examples of future research questions could include: Given the correlation viewed by many Indigenous peoples between colonialism, capitalism, and climate change, what strategies for alternative pathways forward beyond a growth economy do Indigenous peoples within the Colorado Plateau region and beyond perceive?; What are examples of perceived key strategies for Indigenous community-building that can be applied beyond

Indigenous communities and how can these be spearheaded by Indigenous peoples?; and How do Indigenous peoples perceive balancing cultural preservation and ancestral knowledge with the need to navigate an alternative healing path forward involving Indigenous and non-Indigenous actors?

CONCLUSIONS

This study entailed designing a respectful methodology to answer the research question, "How do Indigenous communities in the Colorado Plateau region understand climate change and examples of climate resilience?" [21]. Though our talking circles with community members, organizational liaisons, and NATURE program participants, we found that many Indigenous peoples in our study paired environmental injustice with capitalism, where capitalism drives environmental degradation and extraction and often leaves Indigenous communities to bear the burden of pollution and its associated health impacts. The foundational connection between capitalism and climate change in Indigenous communities was also tied to ongoing governmental mistrust.

Examples of climate resilience shared by participants included the ongoing tradition and need for intergenerational knowledge sharing, environmental education (especially with youth), building strong community relationships, volunteering through public service, engaging in political processes through voting and education, and preserving cultural practices. Agriculture, community-building, and the education of future generations were identified as crucial pillars contributing to community empowerment and resilience, and participants highlighted that agriculture couldn't thrive without better water access and quality.

The inclusion of Indigenous perspectives on climate change offers valuable insights into the complex social and ecological dynamics of this global issue. Centering Indigenous knowledge and practices, recognizing the importance of Indigenous sovereignty and self-determination, and being transparent in research result in more inclusive and potentially effective approaches to addressing climate change. By prioritizing the needs and preferences of Indigenous communities in climate change research, it may be possible to develop more sustainable and effective solutions to this global issue. This research helps fill a gap in understanding of first-hand experiences and perceived threats to Tribes in and around the Colorado Plateau region; especially as these Indigenous communities are often excluded from decision-making processes related to climate change, leading to further marginalization and inequality [1,21].

Our findings highlight that there have been lasting impacts from colonization and exploitation of Tribal lands and people, education, and physical resources (i.e., policy education, water filtration, and economic infrastructure). We learned that it is best to collaborate from the perspective of a student rather than an academic, and transparency and

being able to actively listen and grow from our lessons learned are paramount.

AUTHOR CONTRIBUTIONS

BH and RBM designed the study. BH and DS facilitated the talking circles. BH created the code chart and analyzed the data. BH, RBM and DS wrote the manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Additional insights into the study, advisory board, talking circle guide, and the data are available online at https://digitalcommons.usu.edu/etd/8897 [21].

APPENDIX

Question Themes and Examples

NATURE participant questions:

a. These questions sought feedback on participant preferences for a curriculum and ways to enhance its accessibility to Indigenous participants.

- Course Initiation: “What would you identify as some of the top climate change needs in your community, and what are the challenges (or barriers) to integrating solutions for those needs?”
- Course Reflection: “What do you wish the course would have addressed (at all or more in-depth)?”

Organization and Community questions:

a. Questions were crafted to highlight their community identity, sharing information, and dynamics in climate change action.

- Community: “What kinds of activities help you & others build a sense of community?”
- Climate Change: “Could you describe some of the climate change impacts you have experienced (or been impacted by) as an individual and have seen as a pressing issue within your Native communities?”

Climate Change and Community Code Chart

Code	Code Description	Code Frequency
Cultural practices	Importance and components of cultural practices	29
Public service	Explains times where help has been given or received during hardship and otherwise	27
Agriculture	Agriculture or agricultural practices	26
Community	Components of community in general or theirs specifically	25
Exploitation	Mistreatment of communities and their resources	22
Pollution	Pollution or aspects of pollution they have seen	20
Caretakers of the Earth	Mentioned directly or related examples provided when talking about climate change	20
Development	Examples of the ways communities are or are not developing	20
Lack of access to resources	Barriers faced when trying to access financial and natural resources	20
Environmental education	Mentioned directly or explains components of environmental education	18
Environmental injustice	Mentions of environmental pollution or purposeful degradation that has had a lasting impact on the community	16
Knowledge sharing	How they share knowledge or barriers to knowledge sharing between generations	15
Capitalism	Contributions to a capitalist society	15
Human health	Illnesses brought on by climate change both directly and indirectly	15

Climate Change and Community Code Chart. *Cont.*

Code	Code Description	Code Frequency
Climate change	Direct mention of climate change or explains components of climate change	14
Water	Lack of water and poor water quality	13
Next Generation	Responsibilities of the next generation	13
COVID	Mentioned COVID directly when discussing hardships	12
Education	Ways community members interact with educational materials and outreach	12
Communication	Explains examples of communication pathways	11
Trust	Mistrust or building of trust	11
Extraction	Mentioned directly or explains components of extraction	10
Colonization	Colonization or power dynamics	10
Sustainability	Taking care of the environment taking care of the self, self sufficiency	10
Relationship with government	Fear of government, relationships with government over time, and government exploitation	10
Privacy	Preservation of aspects of their culture, including in academic research	9
Language	Times where they use their own language or when they felt misunderstood	8
Resilience	Mentioned directly or explained how their community survives hardship	7
Policy	Times where policy could have made a difference or barriers to policy	7
Assimilation	Mentions of assimilation programs or moments they felt forced to work within a colonized system	6
Injustice	Examples given of times they were mistreated, kept in the dark, or lied to	5
Racism	Times they have experienced racism directly or resources that are designed in a way that makes it difficult or impossible for their community to use	5
Solutions	What justice and solutions may look like in their community	5
Flooding	How flooding contributes to ecological degradation and washouts	4
Defaced	Mistreatment of sacred sites and Indigenous land	4
System change	Ways that oppressive systems need to change	4

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