SUPPORTING TRIBAL ADAPTATION THROUGH CLIMATE SERVICES

Evaluation Study of the South Central Climate Adaptation Science Center's Tribal Engagement Program

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on behalf of the South Central CASC Performance Evaluation Committee

Cover photos: Rio Chama near Abiquiu, New Mexico by Raychel Sanner (left); Glass Mountains, Oklahoma by Noah Baughman (middle); Cypress trees at Lake Martin, Breaux Bridge, Louisiana by Joshua J. Cotten (right). All images licensed under Unsplash License.

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CONTENTS

1 EXECUTIVE SUMMARY

Adapting to a rapidly changing and increasingly chaotic climate presents unique challenges for Indigenous peoples and nations. In the US, white settlers and then the government forcibly displaced tribes onto lands that are among the most vulnerable to climate change. Ongoing social, political, and economic marginalization also increases the vulnerability of tribal communities to climate impacts. The climate crisis now threatens vital cultural resources and livelihood practices that have sustained tribal communities for generations [1]. For many tribal governments, fragmented jurisdictions, limited financial resources, and low technical capacity complicate their ability to respond to these changes [1, 2]. Despite the challenges, tribal nations demonstrate remarkable resilience and innovation in protecting their land and people [2].

Within this context, researchers and practitioners increasingly call for "actionable science" that can inform climate adaptation efforts [3-5]. The US Geological Survey's (USGS) network of Climate Adaptation Science Centers (CASCs) has been at the forefront of this work with tribal communities, with all nine regional centers working to support climate adaptation in Indigenous or tribal communities. For the South Central CASC, work with tribes and pueblos, intertribal organizations, and Indigenous communities began when the CASC was established in 2012 [6]. Its annual "host agreement" funding from the USGS includes a full-time tribal liaison and sustainability scientist, fulfilled through the Chickasaw Nation (as a member of the South Central CASC consortium). By 2014 and 2022, the CASC added a second and third full-time tribal liaison, respectively, funded primarily through the Bureau of Indian Affairs, with additional support from USGS and the University of Oklahoma.

This report explores how services from climate science organizations like the CASC can support the work of tribal nations to respond and adapt to climate change. We present findings from an evaluation study of the South Central CASC's Tribal Engagement Program (TEP), a project designed to better understand: (1) tribal climate adaptation challenges, priorities, and needs, (2) how tribal nations engage with research and data, and (3) how climate services can help address tribal climate adaptation challenges.

Overall, the findings reveal tremendous—albeit often uneven and slow—progress in tribal climate adaptation despite systems seemingly designed to obstruct this work. Federal funding structures create "grant treadmills" where tribal professionals must continuously scramble to fund their departments and administer short-term grants, diverting time and energy from the deeper work of building climate capacity and resilience. Tribal data and research needs are often oriented towards this grant process, focused on accessing or collecting basic data that can justify adaptation work to funders. Other tribal research needs focus on the cultural impacts of climate change and incorporate qualitative and community-centered approaches. In either case, tribal scientific needs misalign with the type of research valued and promoted by large institutions, which emphasize novelty and generalizability over more applied and local concerns. Given these barriers and misalignments, services that help tribal professionals navigate different bureaucratic and institutional systems were among the most valuable for supporting climate adaptation efforts.

Key Findings

During 2021-2022, we conducted in-depth, qualitative interviews with 33 tribal environmental professionals and others supporting tribal climate adaptation in the South Central CASC region (Louisiana, New Mexico, Oklahoma, and Texas). We organize the interview findings into three sections: (1) the state of tribal climate adaptation, (2) benefits and value of South Central CASC engagement, and (3) opportunities and future directions.

The state of tribal climate adaptation. Findings on the state of tribal climate adaptation contextualize the work of the South Central CASC Tribal Engagement Program (TEP) within the current conditions, challenges, and work of tribal environmental and natural resource departments. Although tribal nations vary greatly in their size, capacity, culture, and political and economic conditions, several common themes emerged across tribes.

- *Contextualizing tribal climate adaptation.* Tribal departments rely heavily on federal grant funding to operate. As a result, their work is defined by grant cycles and resource limitations, including limited time, staff, and money. This context shapes how tribal staff approach climate adaptation work. In general, climate adaptation has not been institutionalized within tribal departments but advances because individual staff members see climate action as important and find ways to incorporate it into existing responsibilities.

- *Tribal climate adaptation work.* Creative and diverse forms of climate adaptation are occurring within tribes, despite the institutional barriers and resource limitations. The formal planning process (consisting of vulnerability assessment, adaptation plan, and implementation) represents one of the primary pathways through which tribal departments come to climate adaptation work. However, this approach requires substantial technical expertise, time, and funding. As a result, tribal staff frequently found other, less formal ways of incorporating climate action into their work and described a wide variety of activities as important for community resilience, including youth engagement in climate education and community gardening.
- *Research collaborations.* Most tribal staff interviewed had not participated in climate related research. Participants expressed interest but faced multiple challenges, including finding the time or research partners and misalignment between Indigenous and Western approaches to science. Those who have participated in research generally reported a positive experience and saw the value of the research products and process.

Benefits and value of South Central CASC engagement. Participants described multiple benefits gained through their engagement with the South Central CASC that we divide into four categories: educating, connecting, amplifying, and navigating.

- *Educating tribal staff, leaders, and communities.* Across services, participants stressed the educational value of the TEP. Educational opportunities came both through training workshops and direct one-on-one support. Participants explained that these services provide important foundational information about climate change and adaptation, particularly because few tribal staff come into the position with a climate background, and departments tend to have high turnover rates. Educational services also play an important role in raising general awareness about climate change among tribal communities and leadership.
- *Connecting tribes with adaptation professionals and each other.* Participants saw the relationship-building value of the TEP as equally important as the educational. South Central CASC tribal liaisons represent not just technical experts, but mediators and connectors who provide trusted information and access to broader networks of scientists and adaptation professionals. Tribal staff also valued training workshops and other events for the opportunity to connect with, and learn from, other tribal staff doing similar work.
- *Amplifying tribal values and priorities.* Strong relationships between liaisons and tribal staff allow the TEP to provide culturally appropriate and context specific information that addresses the values and priorities of tribal communities, as well as amplify those values and priorities within institutional spaces. Partnering organizations, such as federal agencies and other research centers, also described how partnerships with the TEP enhanced their own capacity to provide services in support of tribal climate adaptation.
- *Navigating institutional contexts.* The TEP provides important assistance navigating institutional contexts, helping tribal partners overcome institutional barriers embedded within different administrative and bureaucratic systems. Support in this area includes guidance on navigating the formal planning process, connecting tribes to funding opportunities, and protecting the time and energy of tribal staff.

Opportunities and future directions. Findings on opportunities and future directions describe participant ideas on how TEP services can continue to support tribal climate adaptation work and needs.

- *Educational opportunities.* Most educational suggestions represent continuations of current services, with some opportunities to expand or strengthen services in specific areas. Tribal staff appreciated training workshops that included hands-on, applied, and interactive learning. Some participants were also interested in seeing a peer-mentoring program to strengthen relationships among tribes, as well as educational opportunities focused on tribal leadership.
- *Research opportunities.* Research needs of most interest to participants focused on basic data collection and the impacts of climate change on cultural resources and practices. Participants saw the qualitative and community-engaged aspects of research as particularly important and the need for more research opportunities that align with Indigenous approaches to science.
- *Internal opportunities.* Participants suggested opportunities for the TEP to increase its organizational capacity and build out new services. Potential areas of expansion include targeting audiences beyond environmental

and natural resources departments, increasing services to non-federally recognized tribal communities in Louisiana and Texas, and more robust communication and outreach to increase knowledge of the South Central CASC among tribes. Increasing stability in the tribal liaison positions was also seen as important for developing and maintaining strong relationships with tribes.

Additional Recommendations

We encourage the South Central CASC to continue experimenting with climate services to support tribal climate adaptation (section 4 of the report offers additional program recommendations from the Performance Evaluation Committee). However, many of the issues raised by study participants implicate deeper problems related to the misalignment between tribal needs and institutional structures that cannot be solved by the South Central CASC alone. We therefore stress the need for increased support and consideration of tribal needs across federal agencies and academic institutions. Our recommendations in this area include:

Increasing programs and support for tribal climate adaptation. The CASC network, reflecting the mission of the USGS, supports the climate adaptation work of natural and cultural resource managers. Study participants, however, saw the need for more integrated approaches that cut across sectors by also providing climate services related to transportation, public health, recreation, and housing, for example. The CASC may be able to provide some support outside of its core areas but lacks the capacity and expertise to meet all tribal climate needs. Other agencies and programs should develop their own internal capacity and programs to support tribal climate adaptation.

Federal agencies and organizations frequently consult CASC tribal liaisons, demonstrating the demand and value of the tribal engagement expertise within the CASC. Yet this support should not substitute for organizations developing their own tribal engagement programs that can complement services provided by the CASC. Notably, these programs must go beyond implementing formal and legally mandated tribal consultation, a focus that characterizes many federal tribal relations programs and frequently amounts to fulfilling minimum “checkbox” requirements. Likewise, universities can invest more in extension-style programs that engage tribes across a variety of areas. Findings from the South Central CASC evaluation can help inform these programs. Specifically, our findings stress the importance of developing personal relationships, responding flexibly to emerging needs, and providing services that align with both Indigenous conceptions of resilience and practical considerations of tribal goverance.

Creating funding and research opportunities that better reflect tribal needs and priorities. Federal climate funding has increased substantially in recent years, particularly with the passage of the 2022 Inflation Reduction Act which allotted $385 million for tribal climate action through the Bureau of Indian Affairs (BIA). Participants recognized the current flush of financial resources as part of the normal fluctuations in funding cycles and, while welcoming the opportunities, continue to experience limited capacity to capture the funding. Additionally, these funding mechanisms may replicate the “grant treadmill” problem that makes long-term planning and action difficult. To counter this problem, we encourage funders to create more flexible and long-term grant programs that include opportunities for capacity building, supplement or bridge existing grants, and recognize the diversity of approaches to tribal adaptation and resilience.

Tribal nations would also benefit from research opportunities that can accommodate a broader range of capacities and needs. Tribal professionals often did not see the relevance of research participation for their climate adaptation work or struggled to fit research into their existing workload. In addition to more and better funded university-based tribal engagement programs that can establish and maintain long-term relationships between researchers and tribal communities, this gap can be addressed by encouraging research projects that fund staff time, incorporate capacity building, and collects basic environmental data. Continued education and guidance for non-Native researchers is also needed to increase their competency in working with tribal communities and governments.

2 INTRODUCTION & BACKGROUND

The South Central Climate Adaptation Science Center (CASC), located at the University of Oklahoma—Norman campus, includes a Tribal Engagement Program (TEP) as part of its mission to make science actionable for natural and cultural resource managers and help communities adapt to a changing climate. The TEP has been part of the South Central CASC since its founding in 2012, serving 68 tribes within the south-central US (Louisiana, New Mexico, Oklahoma, and Texas). The program includes three core services to support tribal climate adaptation: (1) training workshops, (2) student internships and youth engagement, and (3) research partnerships. A more detailed description of these programs and how they relate to the TEP organizational mission can be found in the Appendix (see section 6.2.1), as well as the South Central CASC's tribal engagement strategy [6].

This study represents the first comprehensive evaluation of the South Central CASC TEP to assess its work supporting tribal climate adaptation. The project, developed in collaboration with an 18-member Performance Evaluation Committee (PEC), takes a three-pronged approach that includes a case study, interview study, and development of internal mechanisms for ongoing program assessment and improvement (see 6.2.2 in the Appendix). This report details the findings from the interview study, where we sought to address three main questions:

1) What climate adaptation challenges, priorities, and needs do tribal nations in the south-central US region face?
2) How have tribal nations engaged with scientists, research, and data in their climate adaptation work?
3) How has the South Central CASC helped to address tribal climate adaptation challenges?

To answer these questions, we conducted semi-structured qualitative interviews with 33 people working in tribal climate adaptation in the south-central region, including tribal staff, South Central CASC employees, tribal liaisons with federal agencies and other climate science organizations, and university or academic researchers (for more on study methods, see 6.1 in the Appendix).

The next section reports the interview study findings, followed by recommendations from the PEC on the future direction of the TEP. Although primarily designed to inform internal organizational decisions about the TEP, the study's findings also speak to broader issues related to tribal climate adaptation and the effective provisioning of climate services. As such, the report seeks to contribute to broader conversations about how we can adapt to the changing climate in equitable and just ways that center the original caretakers of the land.

Acronyms

BIA	Bureau of Indian Affairs
CASC	Climate Adaptation Science Center
PEC	Performance Evaluation Committee
TEP	Tribal Engagement Program
RFP	Request for proposals
USGS	US Geological Survey

Key Terms

Adaptive capacity: The ability of social and ecological systems to adapt to climate change [7], in a way that supports tribal sovereignty and cultural flourishing [8]. For Indigenous peoples, adaptive capacity is rooted in webs of relationships with both the human and more-than-human world [8].

Climate services: Resources—including data, knowledge, and tools—that support climate action and adaptation decisions [9] [Jacobs, street]. Effective climate services are context specific, require long-term trusting relationships, and rely on skilled science translation and communication [9, 10].

Cultural resources: Culturally significant landscapes, sites, objects, species, and practices. Most cultural resources management focuses on tangible heritage (e.g., artifacts and buildings) [11], but we stress the importance of community and Indigenous values and priorities for determining cultural resources of interest.

Indigenous knowledges: Indigenous peoples' systems of observing, researching, and learning about the world that enable them to live and adapt within an ecosystem [12].

Indigenous peoples: Self-determining societies that predate the US and maintain collective ties to their ancestral homelands, including federally- and state- recognized tribes and unrecognized tribes in the US [12].

Sovereignty: The right of Indigenous peoples to self-govern and determine their own way of life and future [13].

Tribes: In US federal Indian law, the central governments of Indigenous nations.

3 STUDY FINDINGS

Reflecting our guiding questions, study findings are divided into three sections: (1) the state of tribal climate adaptation work, (2) value and benefits of engagement with the South Central CASC, and (3) opportunities and future directions of the TEP.

3.1 THE STATE OF TRIBAL CLIMATE ADAPTATION

This section explores the current state of tribal climate adaptation work, focused on (1) the institutional context in which tribal climate adaptation work occurs, (2) current forms of climate adaptation work occurring within tribes, and (3) tribal participation in research. This information provides insight into the challenges and realities of tribal climate adaptation work to inform how services can best meet tribal needs.

3.1.1 Contextualizing tribal climate adaptation work

Interview findings show that the broader institutional context in which tribal climate adaptation occurs is defined by grant cycles and resource limitations.[1] Although the size and capacity of tribal departments varies widely, nearly every tribal environmental professional interviewed described funding, staffing, and timing challenges that shaped how they approach climate adaptation work.

Tribal environmental and natural resources departments rely heavily on federal grants to operate, often with little or no additional funding sources. These federal grants are often short-term, inflexible, and competitive, making it difficult for employees to complete projects in the manner and timeline they would prefer. For example, one tribal environmental professional described how grants hindered long-term projects and introduced uncertainty that made planning difficult:

> *[When] you work on grants, it's year-to-year most of the time. And a lot of times you don't get things done in a year... Grants [make it] hard to plan for the future because… you don't know if you're going to get those funds or not… And it's frustrating too when you're trying to do a project and you're already writing a grant for your next one to try to keep yourself going.* (Participant 25)

Another participant echoed these concerns and directly implicated short-term funding as a barrier to building greater capacity: "We're grant funded, 100 percent grant funded. We have one year to get this done, so our focus is one year, one year, one year, one year. And that doesn't allow for capacity to be built at all" (Participant 01).

THE IMPORTANCE OF CONTEXT

Understanding context is crucial for providing effective climate services. The quote here, from a participant experienced in facilitating workshops with scientists and resource managers, shows why context is important for making research "actionable."

> On the second day of [the] workshop, one of the scientists was like, "OK, so it sounds like this is the research agenda that we need to fill the science needs. Is that right?" And the [resource] manager's like, "Yeah, yeah, totally. Awesome."
>
> And then I said, "OK, great. So who would use that information and how?" And without hesitating, one of the resource managers said, "Well, no one in my agency would actually use that information because it's geared towards strategic decision making, and my agency does pretty much all opportunistic decision making." (Participant 19)

In this example, the resource managers and scientists agreed on the scientific gap, but the research would not be "actionable" because it did not match how the department operated in practice.

[1] A 2019 Government Accountability Office (GAO) report found that funding and capacity constraints also affect key federal agencies serving tribes, including the BIA, Bureau of Indian Education (BIE), and Indian Health Services (IHE). These resource constraints have resulted in inadequate funding for grant programs to meet tribal needs [14].

In addition to the planning difficulties, many grants come with "strings" and restrictions that limit how staff can spend the funds. These restrictions frequently prevent employees from purchasing the supplies and equipment needed to fully support their work. Examples included prohibitions against using funds to cover printing costs for outreach material, food for meetings and events, new computers, and building repairs. Many federal grants also restrict funds to use on trust or reservation lands, preventing tribes from adapting at the ecosystem level. In other instances, grants simply are not large enough to cover both salary and material needs. As a result, participants felt as though they lacked the resources to properly complete projects or grow their capacity:

> *Purchasing equipment is always a huge challenge because our grants mainly cover our salaries in order to do the objectives. But that gives us the challenge of doing these objectives without the correct equipment sometimes.* (Participant 11)

> *The grants don't necessarily cover the kinds of things [needed] for us to grow and develop.* (Participant 12)

While staff could seek out supplementary funding for the supplies and material needed, this created additional work in writing, administering, and executing new grants. Because of these resource limitations, many of the things that participants wanted to do—including climate adaptation work and research—at times felt out of reach or had to be delayed.

Time and staffing issues emerged as another common challenge related to funding structures. Nearly every tribal employee interviewed described wearing "many hats" within their organization and taking on more work than they had the staff or time to comfortably accomplish. Participants oversaw multiple and diverse grants simultaneously, ranging from recycling programs and environmental education to air and water monitoring. Some also had positions within multiple offices, for example occupying roles in natural resources and emergency management departments. Because funding for both projects and salaries came from grants, departmental staff sizes tended to be small, and participants indicated they could use more people to help with the workload. In the words of one participant, "the major barriers would be just not having enough time and people" (Participant 31). Not all grants provided salary support to hire and train additional staff, and those that did meant that existing employees would need to hire, train, and manage the new staff—a potential time and resource sink given the short-term nature of the grants and uncertainty of future funding. For some departments, recruitment and retention challenges exacerbated staffing issues. Notably, departments in rural areas often reported difficulties finding people willing to live and work in relatively remote locations and in positions with modest pay. This problem contributed to high turnover, a common problem across tribal departments.

Finally, departmental funding structures meant that administrative responsibilities consumed a large amount of staff time and energy to secure and manage grants and satisfy bureaucratic reporting requirements. Particularly for participants at the director level or equivalent, the aspects of the job that first attracted them—often doing hands-on and outdoor work—had been largely displaced by administrative duties. Participants recognized these tasks as a necessary, if unfortunate, part of the job. Particularly in small departments, staff struggled to strike a balance between doing the environmental or adaptation work and the administrative tasks needed to support that work. As one participant explained, "Funding is a huge issue for us… We get these different grants to cover things [we need] but then that means that there's more work, there's more objectives with each grant, and there's only two of us" (Participant 11). Participants also stressed that, like any governmental job, changing political leadership and priorities affected what they were able to accomplish. Most described strong and supportive relationships with tribal communities and leadership; however, citizens and leaders were not always knowledgeable about the work that went on within departments and keeping climate adaptation on their radar as a priority required constant work.

Despite the challenges, participants found ways to procure the necessary funding, grow departmental programs and capacity, and serve their communities in creative and innovative ways. The wide-ranging nature of their work also means that employees developed an impressive depth and breadth of expertise. Unlike state or federal environmental agencies, few positions within tribal environmental departments were narrowly specialized or had strictly delimited responsibilities – indeed, multiple participants described building their departments from the ground up. Participants thus had wide latitude in determining what projects they would pursue and autonomy in carrying out the work (albeit within the confines of existing institutional structures). They brought this expertise and creativity to climate adaptation and resilience work.

3.1.2 Climate adaptation work

The "many hats" of tribal employees means that climate adaptation represents only one of many demands on their time and energy. On top of this, climate work brings its own unique challenges. First, climate adaptation and resilience generally have not been well institutionalized within tribal governments. This means that doing climate adaptation often represented "optional" or "extra" work rather than an expectation or requirement. Second, although many have scientific backgrounds, few participants came into their positions with background or training in climate change and adaptation specifically. Doing climate adaptation work therefore frequently means taking the initiative to learn a new area, identify and apply for grant funding, and assume new project management and administrative responsibilities with few additional resources. Participants nonetheless spoke of wide-ranging projects and activities that they considered important for increasing tribal adaptation and resilience to climate change. Many participants had begun the planning process to develop and implement a formal climate adaptation plan for their communities, while others sought to incorporate climate action into their existing work in less formal ways.

The formal planning process. Scientific and governance institutions approach adaptation work primarily through the formal planning process (see Figure 1). Although models vary, this process typically entails three sequential steps: (1) conducting a vulnerability assessment to identify species, habitats, or systems (natural, social, or built) at risk of climate impacts, (2) creating an adaptation plan documenting strategies and priorities for managing and minimizing climate impacts, and (3) implementing the projects laid out in the adaptation plan. Because funding mechanisms often follow this model, the formal planning process is also how many tribal professionals that we talked to first came to climate adaptation work and began engaging with the South Central CASC. One participant, for example, described how many tribal departments first begin climate work:

> *It's really kind of absurd to say that you don't really get into climate change until you have a grant but sometimes that's how it works within our communities. You don't really get involved until, "Oh, now I have federal funding from the BIA to build an adaptation plan. Well, what's the first thing I need to know?"* (Participant 01)

In this example, tribal staff began attending training workshops with the South Central CASC and other tribal environmental organizations to deepen their understanding of climate change but also learn how to execute the formal planning process. This model also structured how many tribal departments approach climate adaptation work.

Figure 1. Model of the formal planning process. This model represents the predominant approach of climate institutions and funding mechanisms.

Most tribal staff we talked to had engaged with some aspect of the formal planning process. Perspectives on the value and appropriateness of the model varied but many tribal staff, particularly those engaging with climate work for the first time, found the process overwhelming given their available time, knowledge, and resources:

> *We've not done [a vulnerability assessment] here... Nobody was willing to do the work because it was too overwhelming. Whenever we'd go to these trainings and see these things and think, "Where are we going to start?"* (Participant 20)

> *I definitely feel like the amount of training available to us and templates and tutorials and things like that don't give us enough background to tackle this [planning process]. There's not enough knowledge most of the time... If you're just some person coming in, you're trying to figure out how to do a vulnerability assessment, and go into the planning phases, and then implement it. Then yeah, I do feel like the resources that we do have available right now aren't enough.* (Participant 11)

Some departments turned to outside contractors to help complete the work, but participants described challenges with this route as well. Contractors may have a poor understanding and no prior experience working with tribal communities. And even if they successfully complete a vulnerability assessment and adaptation plan, it might just "sit on a shelf because there's no one to go after any other funding to implement the findings" (Participant 18). Finally, on a more fundamental level, outsourcing the work does not help tribal staff and departments grow their capacity to do climate adaptation work.

Because the formal planning process can be expensive, time consuming, and technical, some tribal staff described the approach as a poor fit for their departments. One participant with experience supporting and facilitating tribal climate adaptation work explained their perspective:

> *I am increasingly skeptical that the planning process fits a lot of these communities, particularly in the way we're used to seeing it. You know, vulnerability assessment, adaptation plan, implementation. We've got to find funding for each one of those and… there's so many institutional barriers to making that happen.* (Participant 03)

As described above, climate adaptation grants are often associated with a specific stage in the formal planning process. Each phase requires separate expertise, funding, and administrative responsibilities. While likely intended to make the process more manageable, partitioning climate adaptation into discrete steps in this way also introduces frustrations and barriers to completion. Multiple tribal staff said the process just took too long. The timeframe did not match the urgency of the problems they faced. Others said that their vulnerability assessment provided little additional information for what they knew needed to be accomplished. Another participant expressed their frustration that they were unable to fix relatively simple problems identified during the vulnerability assessment:

> *Implementation is a huge hindrance. Because we can identify the problem, we can assess the problem, we can provide a recommendation for the problem. But we can't fix the problem ourselves, you know, in our department with our funding. So that limitation kind of handcuffs us. It's like we can get to the finish line, but we can't break the tape. That's the frustration.* (Participant 17)

Frustrations with the formal planning process, while common, were not universal among study participants. Some tribal staff found the process valuable for identifying vulnerabilities, prioritizing projects, increasing departmental capacity, and generating support from the community and leadership.

Alternative approaches to climate adaptation. The formal planning process is not the only way that tribal staff approach climate work. Participants discussed a variety of actions and activities that they see as important for increasing community adaptation and resilience, even if the approaches are rarely explicitly labeled or recognized as climate actions. Often, these alternative efforts simply represent continuations of important social and cultural practices within community life. A researcher and collaborator explained how outsiders sometimes interpretated these actions as "climate adaptation."

> *A lot of times, people are already doing and engaging in disaster preparedness efforts or climate actions, but not necessarily labeling them as such. An outsider might come in and say, "Wow, that's a great climate adaptation action." It's what they're already doing to survive and thrive and stay where they are.* (Participant 07)

The most common activities that participants explicitly connected to community resilience and adaptation were community education and outreach, particularly involving children and youth, and gardening projects (see Table 1). Participants viewed outreach and education as important, and often the most fulfilling, aspects of their jobs. Community outreach ensures that adaptation work remains responsive to community need, enables citizens to make informed decisions to protect themselves, and generates community support. Tribal staff described the importance of activities

involving children and youth for passing on culturally significant knowledge, such as the Indigenous names of plant and animal species, and shaping the next generation of environmental stewards:

> *[The tribe hosts] youth camps each summer… [T]hey say that they want the youth to understand the science and the issues, they want them to get a broad exposure and see how the traditional ways of knowing are complementary and interwoven with sea level rise projections [and] the science behind restoration decision-making so that those youth grow up and… they can be voices for being sustainable in these places, [and] can influence decisions made by the state, but also have firm rooting and grounding in their traditional ways and appreciate those.* (Participant 32)

Community gardening emerged as another common activity that may not be widely considered climate adaptation. Participants described gardens and greenhouses that provide educational opportunities and promote self-sufficiency and food sovereignty. Other climate adaptation strategies discussed by participants included river and stream restoration, energy and water conservation, disaster mitigation and preparedness, and basic data collection (see Table 1). In these examples, tribal staff incorporate climate change in more informal or indirect ways, making it less likely that formal institutions will recognize or "count" the work as climate adaptation. Yet for many tribal staff, these alternative approaches often provide an easier entry point or work around if larger projects, such as a full vulnerability assessment or climate plan, felt out of reach or overwhelming due to resource limitations. These examples also speak to differences in how tribal communities conceptualize climate adaptation work compared to formal institutions.

Table 1. Examples of alternative forms of climate action outside the formal planning process

Climate Actions	Quotes
Community education and outreach	"We always do an Earth Day event with the kids during April and we always, always try to include climate change just so we're making more people aware so then they can prepare." (Participant 31) "We work in informal education at events that include youth and or events that are specifically targeted to youth where we have games or displays set up to help the participating kids interact and learn about climate change impacts." (Participant 32)
Gardening and agricultural projects	"We're doing a whole project right now on getting schools greenhouses. And just some things that might not sound like climate change, but in the scheme of things is probably involved in that." (Participant 25) "We have some money that came in for food sovereignty for the development of a greenhouse, for example, where the tribes could keep their seeds and propagate their different traditional foods and so forth. [Somewhere protected from] the encroachment of salt water and the heat and the changes of the climate." (Participant 13)
Restoration	"We've been having discussions about what measures to take to contain this water to replenish the watershed up at the higher level in the mountains." (Participant 16)
Energy and water conservation	"We know that [climate change] is a big strain on our energy consumption, especially during the drought time and the stressors of the heat on our buildings to keep a cool… We're trying to do energy audits on [tribal office buildings] just to see if there's something that we can help them out energy wise and conservation wise." (Participant 14)
Disaster mitigation and preparedness	"I do think they're trying to make our newer facilities more sustainable as far as looking at the way things are built. We've got to consider that we're going to have floods... and, you know, what are we going to do when there's more water?" (Participant 10) "I decided to do [a training on] emergency operations plans for rural jurisdictions. That kind of goes directly with what [the CASC] does, just learning what risk we have… and how we can better prepare ourselves for the future when [disasters] happen, because it's inevitable with the climate changing the way it is." (Participant 31)
Basic data collection	"We're trying to get to the point where we can capture some data on the reservation about wind speed, temperature, ground temperature, rainfall… and use that data for our climate change adaptation process." (Participant 14)

3.1.3 Research collaborations

Research collaborations related to climate change and adaptation, while important to the South Central CASC, did not emerge as a priority area for tribal staff. Most tribal partners we talked to had little or no experience partnering on research but remain open to the possibility. Some participants described a lack of opportunity as the primary hinderance for greater research participation:

> *There really hasn't been, from my own experience, a lot of opportunities to partner in research projects. But there's no time better than now, right? We're trying to learn more about climate change, how to use the science, and how to really make it work for us.* (Participant 01)

> *We've made sure that the professors that we talked to [know we're interested in research]. We're like, "Hey, [we're here] if you ever [want to] do any kind of research… and do a partnership where you come and collect data, and then the tribe can benefit from the data that you collect."* (Participant 12)

For others, the primary barrier was timing:

> *It's not just saying, "Hey, no, we just don't want to do [the research]" because we don't want to do it. It's just we have a lot of other projects going and… when you've already committed to something [else]... It's really hard sometimes to squeeze other things in.* (Participant 25)

However, in many instances tribal staff and others working in tribal climate adaptation had difficulty articulating specific research needs or how they could benefit from participating in research. Multiple participants, for example, readily associated research with environmental or public health departments but did not see as much need in the "straight environment" departments. As one researcher we interviewed noted, "there are definitely tribes partnering with universities to do research… But I think those [collaborations] haven't been explored as much on climate change yet" (Participant 02).

Participants also saw conflicting models and understanding of science as contributing to low levels of research participation. For example, when asked about major research needs among tribes, one participant from a partnering organization that supports tribal climate adaptation, explained that they focus more on Indigenous knowledges:

> *I don't always hear, "Hey, we need more of this Western science." I really don't. I hear more about the need for that knowledge to be used together [with Indigenous knowledges] in a really respectful way where neither one takes advantage of the other, where it's more of a collaboration. That stuff's qualitative.* (Participant 28)

In their experience, most of the climate-related quantitative data that tribes may need already exists. The research needs instead lie more in the qualitative realm to figure out how to collaborate respectfully and productively. Notably, this response also implies that these more qualitative needs fall outside the purview or interest of academic research. Another participant made a similar point about how Indigenous science conflicts with Western approaches in a way that can hinder the development of research partnerships:

> *When the tribes need to collect basic information, it's often of a different type than what outside basic research scientists are interested in. This goes back to Western science versus traditional ecological knowledge… In my limited experience tribes are interested in how climate affects… their traditional practices. Which for them is a basic type of information. Yet it might not be gathered in a way that follows the so-called scientific method.* (Participant 04)

These examples suggest that institutional barriers also make tribal participation in climate research difficult.

A few tribal staff interviewed reported positive and valuable experiences with research collaborations but most examples of successful partnerships came from researchers or tribal liaisons involved in the work. These examples include projects related to stream flow monitoring, indoor air quality, and water quality research. The successful examples, as well as the openness of other tribal staff to participating in research given appropriate resources and support, suggest the potential for promising future work in this area.

3.2 BENEFITS & VALUE OF SOUTH CENTRAL CASC ENGAGEMENT

The South Central CASC Tribal Engagement Program (TEP) focuses on building relationships with tribal nations to better understand and meet their climate adaptation needs. This section explores how tribal professionals and other participants have engaged with the South Central CASC and how they view the benefit and value of this engagement. We found four main categories of benefits: (1) educating tribal staff, communities, and leadership, (2) connecting tribes with each other and with scientific experts, (3) amplifying tribal values and concerns within institutional spaces, and (4) navigating institutional context of science and funding bureaucracies. These benefits illustrate the different ways that the TEP's work has translated into greater tribal resilience or adaptive capacity.

3.2.1 Educating and the multiple uses of climate information

Participants placed a high value on the educational benefits of the South Central CASC for understanding climate change and its impacts. Education was the most frequently mentioned benefit of engaging with the South Central CASC, often connected to attendance and participation in the Center's training workshops. The TEP hosts regular training workshops geared towards the needs of tribal partners, including basic courses like Climate 101 and Adaptation Planning, as well as addressing more targeted topics like culturally significant plants, grassland ecosystems, and coastal restoration. Beyond these courses, South Central CASC tribal liaisons offer one-on-one support through regular phone calls and email outreach that provides additional educational opportunities.

Conceptualizing organizational uses of information

Following a typology developed by Pelz and applied by VanderMolen et al. in the context of resource management [15, 16], we categorize the organizational uses of climate information as:

- **Instrumental:** Information used directly in decision making or actions.
- **Conceptual:** Information used to better inform or educate an individual or organization.
- **Symbolic:** Information used to justify or legitimatize an existing action or decision.

One goal of the evaluation study was to understand not just what tribal staff learned through the program's educational services, but how they put this information to use. How were resource managers applying what they learned in their day-to-day work? What climate adaptation activities or projects did they implement as a result? Notably, tracing the impact and use of new information within organizations is notoriously difficult [17, 18]. The initial questions that we came into the study with also assume that *instrumental* uses (i.e., informing decisions or actions) are the only or most important uses of information and that the process occurs in a relatively linear and straightforward manner [15, 19]. What emerged instead from the interviews was the importance of recognizing multiple uses of information, most of which were not instrumental. Organizational partners with experience facilitating training workshops noted this explicitly:

> *I think the instrumental part [of trainings] is small… Sometimes the use of the trainings will be instrumental and awesome and will make a huge difference that way. But that's not the only use.* (Participant 19)

> *I think that's really important for funders to understand, that it's not just a linear, input output.* (Participant 13)

Few participants talked about using climate information directly to inform adaptation policy, decision-making, or projects. Rather than instrumental, by far the most common uses of climate information were *conceptual*, where knowledge contributed to better informing individuals and organizations.[2] Participants described the knowledge gained through the South Central CASC as valuable for raising the general level of awareness within tribal departments, developing critical thinking skills, and educating communities and leaders. Finally, the *symbolic* use of information was also important, and describes the use of information to justify or legitimize previous decisions or existing plans [16].

[2] This finding is not unique to Tribal contexts. VanderMolen et al. (2020) found that conceptual uses of climate information were also the most prominent use among non-tribal resource managers involved with CASC research more broadly [2].

Conceptual uses. Tribal staff, along with other participants, saw climate education as important first and foremost to raise general awareness about climate change and climate impacts. As previously mentioned, many tribal staff come into the work with little previous experience or knowledge of climate change and adaptation issues (although most did have a science background). This lack of formal background in climate science and adaptation, combined with the high level of turnover within tribal departments, means that foundational training on the basics of climate change remains important. Participants with experience planning and facilitating workshops described the importance and need for this foundational-level training:

> *How I viewed the workshops [was], it's trying to increase the basal level of understanding rather than continuing to engage people at a higher level… We're not ready for that super fine level of detail. We're still at the point where we're just making sure that every natural resources manager understands what climate change is and what climate adaptation is.* (Participant 03)

> *Mostly what we've seen in our region, a lot of tribes are interested in planning and training their employees. Capacity of tribal environmental departments is always an issue. Due to limited resources, there's always turnover of tribal staff. We're really still on the ground level with making sure tribes are properly staffed and educated to make sure they can even identify the issue to begin the process.* (Participant 04)

Similarly, another participant described why they found training workshops as valuable for "getting up to speed":

> *Climate change… wasn't something that I saw a lot of in college. I won't say it was nonexistent because it wasn't. But it didn't receive the emphasis that it does now. So for me personally, I've been kind of behind the learning curve trying to get up to speed so that our program can better design, better plan for projects, and assure the long term survivability or sustainability of projects.* (Participant 23)

Participants with more advanced understanding of climate change and adaptation appreciated the opportunity to continue to grow and learn from the South Central CASC, but also recognized the ongoing need for introductory-level trainings.

Beyond basic education and general awareness, critical thinking skills represented an important but less common benefit of climate education raised by participants. One example comes from a member of a partnering organization who described how the tribes they work with have become proficient at evaluating research studies rather than just accepting findings at face value:

> *I can say that across the board with almost all the tribes that we work with, they want to know how data is collected, who collected it for what reason, the duration of the sample, [sample] sizes and so on… So the critical thinking is tremendous.* (Participant 13)

As described here, the skills gained through training workshops and engagement with climate services proved vital for enabling tribal communities to engage critically with climate information and research more generally. Other participants described how they gained a more holistic understanding of climate change through engagement with the South Central CASC and, beyond basic comprehension, are now able to apply information across different areas of their work and teach others as well:

> *I continue to learn from the CASC…I feel I have a better understanding of how to integrate the science, how to ensure that tribal technical staff have a better understanding when it comes to using it, and making those connections to the forestry program, their rangeland program, their water resources program, even their solid waste program.* (Participant 01)

Although less common than basic knowledge and general awareness, these examples show how through continued engagement, tribal staff can develop higher levels of understanding.

Beyond tribal departments, South Central CASC climate services also contribute to educating communities and leadership more broadly. One participant, for example, explained how they used climate information from the CASC directly in developing education and outreach materials:

> *The [South Central CASC] has been really helpful with offering trainings, both for outreach activities, for digital education or digital storytelling. And just the scientific background on climate and weather and earth processes*

in general… And then I've definitely been able to use some of the trainings, turn them into outreach activities. (Participant 10)

Others described how engagement with the CASC helped them translate and communicate climate change to leadership:

The relationship that I've built from the South Central CASC really helped…our ability to take the information that we're learning on that technical level and digest it, regurgitate it, and then present it to our leaders and communities where it's not so overwhelming. (Participant 01)

This conceptual use of information for educating leadership and communities represents an important benefit of South Central CASC engagement because of the high value that tribal staff place on engaging communities, as discussed in the previous section.

Finally, climate information plays an important conceptual role in grant writing and the formal planning process. Tribal staff explained how they incorporate climate data and information into vulnerability assessments and adaptation plans:

We didn't really start utilizing [the South Central CASC] until we started looking into the adaptation plan… [T]hey helped us out a lot with getting some data for a vulnerability assessment. (Participant 11)

And we can use those studies to further enhance our climate adaptation plan. But [the plan is] still very much in the early works, and we're still trying to figure out how to put all these things together to make it a valuable resource to use for funding. (Participant 12)

Like the quote above, participants often explained how they integrate climate information and data into grant writing to secure funding for climate adaptation work. Because of tribal departments' funding structure and dependence on grants to do climate adaptation work (particularly larger projects), this use of data and information is vital for growing the growing departmental capacity.

Symbolic uses. Participants also saw climate information as playing an important symbolic or justification role within tribal adaptation work. One reason tribal staff emphasized the importance of educating leadership was because they required leadership approval to do the work. As one participant explained:

It helps us when the Tribal Council gets to see the climate information. It's helpful in getting approvals from the Tribal Council, grantees, and decision making for every project we do in the department. (Participant 16)

In these instances, climate information may not change departments' approach or decision making but enables them to demonstrate the importance of the work, or in some cases, gain support to begin the work. Climate information plays a similar symbolic role in justifying the work to external (non-tribal) audiences, and particularly scientific and funding institutions. Notably, tribal staff often discussed the value of vulnerability assessments and adaptation plans as primarily a symbolic resource that would help to justify the work as legitimate to others and access financial resources, rather than tools for decision making and determining the direction of their work in more instrumental ways.

Instrumental uses. Although less frequent than the conceptual and symbolic uses, participants did describe some instrumental uses of climate information, where the information directly informed adaptation decisions and actions. The examples from our interviews illustrate primarily smaller and more informal ways that this occurred. Rather than informing new policies or projects, climate information tended to be incorporated into existing work in more subtle ways. In doing prescribed fires, for example, one participant talked about being more selective about the number of trees cut because of anticipated climate impacts:

When I'm getting a hazardous fuel reduction plot ready to get cut and piled, utilizing the climate change knowledge I've learned, I'm not going to take so many trees because we're going to need them now. In my opinion, some forestry prescriptions call for more than needs to be done, so I have done less by combining climate change, forestry prescriptions, and traditional ecological knowledge into our implementations. (Participant 16)

In another example, a former South Central CASC tribal liaison described a popular training they facilitated on soil health that included a field demonstration on how to fix an erosion gully (see Case Study Report in Appendix 6.3).

Another tribal staff described efforts among New Mexico tribes to develop a South West Tribal Adaptation Climate Menu that would include similar smaller actions addressing common problems in the region that tribes could "plug and chug." Although our interviews did not include examples from users of these services, participants emphasized the potential instrumental value of this type of information and appropriateness for tribal contexts.

3.2.2 Connecting tribes with adaptation professionals and each other

The second benefit of TEP engagement that emerged from interviews was the program's role as a connector, or its ability to facilitate relationships that support tribal climate adaptation work, including connecting tribal staff to adaptation experts and each other. Relationship- and trust-building represent foundational aspects of the TEP that have been built into its structure and strategy from the beginning [6]. For example, South Central CASC tribal liaisons design training workshops not just to impart climate information but also to get to know tribal staff on a personal level, learn about their needs and priorities, and maintain regular contact over time. Likewise, the program's outreach strategy focuses on creating long-term and personal relationships through direct outreach. Our findings show that these activities successfully facilitated trusting relationships with tribal staff. These relationships proved important for enabling institutional and epistemic trust—tribal staff trusted the South Central CASC and the information and advice coming from the organization. As a result, the Center became many tribes' primary, if not only, interface with climate science, data, and institutions more generally and acted as a conduit for connecting tribal staff with additional climate experts and resources. In addition to interfacing with scientific institutions and adaptation experts, the South Central CASC facilitated intertribal relationships and learning, helping to create important partnerships and networks among tribes to enhance resilience and adaptive capacity.

> "The direct contact, reaching out directly and individually to tribes, I think is really a good thing. And I wish more organizations would do that, would follow [the South Central CASC's] lead on that." (Participant 17)

Tribal staff expressed strong appreciation of the South Central CASC because of the personalized relationships that liaisons cultivated. When asked about their experience with the CASC, participants immediately began discussing CASC staff by name. The CASC was not a faceless organization but represented individuals who they knew personally and trusted. Participants attributed the strength of these relationships to the TEP's direct and personalized outreach strategy:

> *[South Central CASC staff] come and visit us…[to] see if there's anything that they can do to help… They reach out a lot, which I love. I love being able to put a face to the name, know someone who I can call if I have a question about resources, funding, training…or research.* (Participant 31)

> *The direct contact reaching out directly and individually to tribes I think is really a good thing. And I wish more organizations would do that, would follow their lead on that.* (Participant 17)

These personalized relationships meant that participants had trusted sources of information to turn to when they had questions or needed assistance. South Central CASC tribal liaisons likewise saw their position in explicitly relational terms:

> *The pueblos and the tribes don't need you to come in and tell them how to take care of their land. They've been doing this for generation after generation. What they really want is for somebody to come in and listen to how they've been taking care of that land and hear what their ideas are and take that back and see how we can make it all merge together. And so it is a gift to whoever gets to have that [tribal liaison] position. It is a gift for that person to be able to go in and build those relationships, and it is very much of a relationship building position.* (Participant 20)

This relational approach enabled the TEP to remain open and responsive to tribal needs, something that TEP staff saw as particularly important given the early stages of much tribal climate adaptation work and the rapidly shifting field of climate adaptation more generally.

Relationship building benefits also came through the TEP's work helping tribal staff navigate climate information and connect to other adaptation experts. The complexity and size of climate science and adaptation means that no one can navigate the field on their own. The TEP provides both an entry point into the field and access to extensive professional networks:

> *You can Google anything and you'll get millions of hits. Or you can go to a CASC and see what kind of information they have and that's a good start. But a lot of people don't know that, especially if you have new staff coming in… which is why [the tribal liaison] work is so important.* (Participant 28)

> *It's the connections I've made, and again as part of the book of experts in different fields, and I can refer to that proverbial rolodex…That's the biggest benefit that I have seen from [the CASC], it's the collaboration and it's the commitment of the players to truly do be on the leading edge of the science.* (Participant 09)

By placing relationships at the center of their work, the TEP also recognizes the importance of relationships for the learning process, an approach that resonated with the experience of our interview participants. For many, the value of the training workshops came as much from the relationships as the information shared. The workshops provided an opportunity to connect with TEP staff, adaptation professionals, scientists, and other tribes. Multiple participants described how these relationships, rather than the workshop content itself, often proved the most valuable:

> *I think [learning] the adaptation planning process came through the networking and the coordination and the collaboration.* (Participant 02)

> *The biggest value that folks have had in attending those [training workshops] is the connection to other people…* (Participant 13)

For this reason, TEP staff maintains a consistent presence within climate adaptation and tribal environmental spaces (e.g., conferences and regional gatherings), which has proven important for building and maintaining professional relationships and networks.

The second aspect of relationship building facilitated by the TEP is connecting tribal departments and staff with each other. Participants stressed the importance of collaborating and sharing ideas with other tribes to learn from the experiences of others:

> *I think for us, just being able to connect with other programs, other agencies, other tribes… If we can connect with some of those folks and just pick their brain about, "Hey, what are y'all doing different than us?" Or "How did y'all get to this step?" or just kind of help us along the way [because] this is something new for me, the climate adaptation and these dollars coming with it.* (Participant 27)

> *We didn't start this environmental program from scratch, trust me. When I came here there was two of us, but we learned from other tribes… The sharing of ideas and just knowing that we're all different, we all live in a different place, but we all have the same goal.* (Participant 25)

Through these experiences, tribal staff could begin to form communities of practice and collaborate on larger projects, a process explored in greater depth within the Case Study report (see Appendix 6.6) [20]. Those further along in the adaptation process also appreciated the opportunity to "give back" by sharing their experiences and expertise at South Central CASC events. One participant, for example, told us:

> *I'm thankful and grateful to [TEP staff] and the Center for inviting me to… tell our story of how we started from nothing…to now being able to give back. And [TEP staff] and the Center's been able to allow us to do that peer mentoring and reaching out and helping lift others and encourage others and let them know it's possible. Because if I can do it, then anybody can do it.* (Participant 17)

This example also shows how the TEP helps to develop climate leaders in this space, where they go from "starting with nothing" to being able to support and mentor others in the process.

3.2.3 Amplifying tribal values and priorities

The third benefit of the TEP was their work creating tools, processes, and services that address tribal-specific values and priorities, as well as amplifying those values and priorities within institutional spaces. Because of their legal status

as sovereign nations and distinct histories and cultures, the needs, values, and priorities of tribal nations and communities differ from non-Native communities. Participants appreciated that the TEP recognized these unique aspects and sought to incorporate Native values into climate services, as well as advocate for tribal needs within other spaces (e.g., academic and government).

The emphasis of the TEP on incorporating tribal values and priorities within their services can be seen in multiple ways, such as including cultural aspects in training workshops and engaging communities and youth. One participant, for example, explained how the cultural components of training workshop keeps them engaged with the Center:

> *[O]ne thing that I like about working with the CASC is they try to integrate the cultural aspects of the tribes… That type of stuff is what keeps tribes coming back, when you're actually making an effort to include the culture and not just the Western aspects of the science.* (Participant 05)

Other participants talked about the importance of the CASC being able to provide information in ways that are "culturally appropriate and context specific." For example, another participant from a partnering organization explained how their approach to the adaptation process differs from other models: "[We use an] overarching Indigenous framework, meaning that we emphasize including culture, language, artwork, anything at all times. So it's very different for tribal communities" (Participant 28).

Although many tribal staff had not yet participated in research opportunities, researchers and partnering organizations saw the TEP as playing an important role in preparing non-Native researchers to work with tribes. One participant, for example, discussed how the TEP can prepare researchers to better understand and navigate the social and political differences between tribes:

> *The South Central CASC has relationships with both the federally recognized and the state [tribes]. And they can really help better understand that landscape and where the different needs are… [As a researcher,] you have to know how to navigate that landscape, you can't just jump right into it. And I think [TEP staff] does a great job in doing that.* (Participant 32)

"One thing that I like about working with the CASC is they try to integrate the cultural aspects of the tribes… That type of stuff is what keeps tribes coming back, when you're actually making an effort to include the culture and not just the Western aspects of the science."
(Participant 05)

Similarly, TEP staff explained how they encourage researchers to remain open and flexible with their projects when approaching tribes and suggest ways that research could better benefit tribes. Importantly, this outcome is only possible because of the strength of relationships and tribal liaisons' ability to listen and relay information. Again, beyond the value of providing better direct services to the tribes, this knowledge helps liaisons represent tribal interests and concerns within institutional spaces in ways that can make other actors more responsive to tribal interests.

The TEP also amplifies tribal values and priorities within institutional spaces by enhancing the capacity of partnering organizations to support tribal adaptation work (or, as they phrased it, "leveraging partnerships"). This amplification was done by coordinating and collaborating on projects with a variety of organizational partners, including federal agencies, university and research organizations, and tribal environmental organizations. One participant from a partnering organization, for example, talked about the importance of working to reduce the burden on tribes and because the need in this area is so great:

> *We talked with the South Central CASC about how we can collaborate more because the need is so great… that any way we can increase capacity to address those needs is helpful… And that not only benefits us, but it also benefits those that we serve and the communities.* (Participant 32)

> *And we have a very good working relationship with all the Climate Adaptation Science Centers… So we try to maintain that because tribes should receive the best help and resources as possible, and there's no room for competition. It's too much work.* (Participant 28)

The partnering organizations we talked to all stressed their strong working relationship and productive collaborations with the TEP. These partnerships increase the capacity of both organizations by pooling resources but also help to fill certain organizational gaps:

> *Partners in general to the [federal agency] are extremely important… [We,] as a federal agency, have certain limitations on what they can and cannot do, and that includes certain funding opportunities, that includes paying for certain things. And so having partners as that third party, if you will, is extremely important to be able to get our program of work across.* (Participant 05)

Through these partnerships, the TEP enables greater institutional support of tribal adaptation work, as well as greater tribal representation within these organizations.

3.2.4 Navigating institutional contexts

The fourth and final benefit of engagement with the TEP is the program's assistance navigating institutional contexts, or the ways that the TEP helps tribal partners overcome institutional barriers embedded within different administrative and bureaucratic systems. This category overlaps with many of the other benefits discussed in this section but makes explicit how the TEP's work helps tribal staff to overcome the many barriers they face in doing adaptation work (explored in section 3.1.1). Examples of how the TEP helps tribal staff to navigate institutional contexts include assisting with the formal planning process, identifying appropriate funding sources, providing institutional legitimacy, and protecting the time and energy of tribal staff.

"The need [for climate services] is greater because more tribes are wanting to do the work and actually have an adaptation plan… They realize [that] in this world, in the Western world, documents are important to the federal government, to funding sources, to have clout… Because a lot of people still don't believe or take oral knowledge as science." (Participant 28)

As discussed above, one of the primary ways that tribal nations engage in climate adaptation is through the formal planning process. The support of the TEP, along with other partnering organizations, proved vital in the ability of tribal staff to navigate this process. As one participant explained, the TEP helped them navigate the entire process and was particularly crucial in the beginning:

> *From our first funding… [our] first proposal [to do a vulnerability assessment], [TEP staff] was there and the [South Central CASC] was there. Because this was brand new for us. We have never done any climate resilience or adaptation planning, and we didn't even know who to call to put out bids… for a contractor to help us develop this proposal.* (Participant 17)

Similarly, a participant from a partnering organization explained how demand is increasing for these types of adaptation services:

> *The need [for adaptation services] is greater because more tribes are wanting to do the work and actually have an adaptation plan… Because they realize in this world, in the Western world, documents are important to the federal government, to funding sources, to have clout... Because a lot of people still don't believe or take oral knowledge as science.* (Participant 28)

As described in this quote, adaptation services focus in part on how to satisfy the expectations of Western science and bureaucracies, enabling tribes to gain funding for the work they want to do. Evidence of this institutional orientation can also be seen in participants' answers to questions about their data and research needs. Often, tribal staff reported that the data or research would be useful for grant writing or documentation purposes rather than adaptation decisions and actions. Similarly, several participants noted that their vulnerability assessment did not tell them much that they didn't already know or change what they thought needed to be done; rather, the process served more of a legitimacy purpose. Again, the problem often wasn't how to create more resilient communities but how to access the needed resources.

Another important CASC service for navigating institutional contexts is providing administrative support to help address the time, funding, and labor constraints that many tribal departments struggle with. For example, participants described how the TEP helps to keep departments moving with adaptation projects and connect them to funding sources:

> *You can tell [TEP staff] tries really hard to get these things going and [to] boost other people's programs and keep things going for tribes. I think that's a lot of it, is just getting the time and the money and the data all worked out to where you can get a project off the ground.* (Participant 10)

> *[TEP staff] was aware of the funding opportunity and as soon as it came out, as soon as the announcement came out, she kept nudging me and nudging me and making sure I was on track, which I needed, and we were able to take advantage of it.* (Participant 27)

Participants saw the ability to capture funding at the current moment as particularly important because of the large amounts available but would need administrative and grant-writing support to make it happen. Tribal liaisons at both the South Central CASC and other partnering organizations understand this type of support as an important part of their job and are particularly mindful to protect the time of tribal staff:

> *The main thing I think is that there's a scarcity of time for a lot of tribal staff. And then in addition to the scarcity of time, there's a scarcity of other people that can help with particular objectives. So a lot of [my work] was figuring out how to absolutely minimize the amount of time that they're spending on stuff.* (Participant 03)

> *The pueblos and the tribes don't have time to go to all of these federal agencies and hear what they're saying. That is the purpose of the [tribal] liaison, go and collect that information and to bring people together whenever it's going to be a good use of their time... There's a lot of people that want to have meetings with tribal people because they need to check a box. Our tribal people have a lot of work to do, they don't have time to be showing up to meetings just to check a box. It needs to be valuable.* (Participant 20)

Again, these types of administrative and support services address the institutional barriers that can hinder tribal climate adaptation work. Although often seen as less valuable or impactful than services more directly related to adaptation projects, like partnering on research or applying new scientific models, they represent an important prerequisite for building capacity and initiating climate actions.

3.3 OPPORTUNITIES & FUTURE DIRECTIONS

The final section of the findings addresses opportunities for new, expanded, or improved services from the TEP to support tribal climate adaptation, as well as opportunities of the TEP to increase its own organizational capacity to support this work. Notably, compared to our other findings, we found less consistency in this area. In response to questions about how the TEP could improve or expand its services, many participants simply responded with "just keep doing what you're doing" and noted their appreciation that TEP tribal liaisons regularly solicit feedback and input. With that in mind, we divide the findings into three key categories: (1) educational opportunities that continue and expand on current training workshops, (2) research opportunities with a strong qualitative, cultural, and community-engaged focus, and (3) internal opportunities to increase organizational capacity to support tribal adaptation.

3.3.1 Educational opportunities

Most education-related suggestions represented continuations of current services, with some opportunities to expand or strengthen services in specific areas. Examples included:

- Focusing on hands-on, interactive, and applied learning. Training workshops with this type of material, for example field demonstrations or learning new programs, tended to resonate the most with participants.
- Incorporating regionally specific content. Some participants in Louisiana, for example, noted that the focus of training workshops often did not apply to them, like wildfires.
- Educating leaders and decision makers.
- Developing a (peer) mentoring program.

We elaborate on the final two bullet points here.

Some participants expressed interest in seeing the TEP focus educational workshops on learning for tribal leaders and elders. This focus was seen as an important part of incorporating the community more generally, as well as involving people with more decision-making power. One participant explained, for example:

> *I think coming to the pueblos would be the best because staff can go to conferences [and] learn the data, but relaying this information to the elders and the Tribal Council is not the same... They need to see what we're seeing.* (Participant 16)

> *I think, to be honest, training people that make the decisions and forcing them to sit down and understand what they're about to make a decision on is paramount. I think that those trainings should be focused on leaders rather than the technical folks.* (Participant 08)

Notably, these participants felt that the CASC would be able to more effectively present climate science and data to tribal leadership, as well as increase its legitimacy because of the Center's institutional affiliation.

A second area that stood out for expanding educational opportunities is developing a formal mentoring program or system for connecting tribal staff with each other. Tribal staff valued training workshops and other events as opportunities to connect and develop peer relationships, but some were more connected than others. Multiple participants noted that greater opportunities for connecting with more experienced tribes would be valuable. For example, when asked what support would help them, one tribal staff said:

> *Maybe just [connecting with] another tribe that's further along in the process than we are or maybe a tribe that already has a full-blown adaptation plan and [could] give us their template or let us see what they've accomplished, and then we can kind of tailor our program to that.* (Participant 27)

Even though they described the TEP as incredibly helpful in navigating the formal planning process, this participant still felt overwhelmed. Other participants talked about their interest in a more advanced, multi-day adaptation planning course or having someone they could call to walk through each section of the adaptation plan as they were putting it together.

3.3.2 Research opportunities

Tribal staff we talked to did not explicitly discuss research as an area of opportunity for the TEP. Instead, the suggestions in this section come from academics and members of partnering organizations or emerge from more general research or data needs raised by tribal staff. Overall, participant recommendations for enhancing tribal research opportunities focused on how the TEP could help address the misalignment between institutional and Indigenous priorities and models of science. These recommendations included:

- Supporting basic data collection and research on cultural aspects of climate change.
- Prioritizing Indigenous science and research models.
- Funding qualitative and engaged research.

> "Working with tribes, I found a lot more general awareness that it's not all about the science, that there are strong cultural elements. And so any discussions around adaptation or decision making or vulnerability need to reflect a community's values. And also potentially non-quantitative sources of information." (Participant 19)

For tribal staff, most research needs center on basic data collection and the impacts of climate change on cultural resources. Participants expressed interest in collecting a wide range of basic data, ranging from air and water quality to wildlife surveys. Cultural topics include climate impacts on culturally significant plant and animal species, as well as traditional practices. However, participants described both types of research, basic data collection and cultural impacts of climate change, as being difficult to fund because institutions often do not see them as high priority or contributing to the wider body of scientific knowledge. The quote here illustrates the challenges of conducting the type of research that participants saw as meaningful and useful for Indigenous communities:

> *Basically, the model of research… I think the CASC should fund… [is] led from a place of helping a community understand itself as opposed to being studied. And as a way of recapturing knowledge and creating internal mechanisms for… allowing the community to better access it… Which is the polar opposite of a lot of the research that is happening.* (Participant 03)

In short, this participant simply did not see a lot of research happening that could increase the resilience of tribal communities because that type of research conflicted with more Westernized science. They went on to explain that outside researchers rarely have a good understanding of research that would be relevant to tribal adaptation.

Another researcher talked about the difficulties they have funding community-engaged and qualitative projects, research important for ensuring that the science reflects and incorporates community values. They explained that:

> *I've been involved in projects that are very little [hard] science, mostly working with stakeholders doing adaptation. And they get turned down over and over and over again.* (Participant 24)

In their experience, community engagement and qualitative research are also the first elements of projects that funders attempt to reduce or cut from the budget. The participant interpreted this feedback as saying that funders simply do not prioritize or equally value this type of research. Although participants acknowledged improvements and increased funding going towards qualitative and community-engaged research, they stressed the need for continued attention to ensure research and funding priorities reflect tribal needs and agendas.

3.3.3 Internal opportunities

Lastly, participants suggested opportunities for the TEP to increase its organizational capacity and build new programs. The previous opportunity areas largely represent extensions of the TEP's existing work that could in theory be accomplished under the existing program (though not without challenges). The suggestions in this section, by contrast, would require significant organizational changes and increased capacity to accomplish. Internal opportunities include: (1) broadening engagement with tribes and tribal departments, (2) enhancing outreach and communication efforts, and (3) increasing stability of the tribal liaison position.

First, some participants saw an opportunity for the TEP to broaden engagement beyond the traditional target groups of tribal staff in environmental and natural resources departments. Because of the core mission of the USGS and CASC network more broadly, most of the TEP's expertise and focus goes towards supporting natural and cultural resource managers. Participants, however, saw the need to serve tribal staff from other areas to increase overall resilience of tribal communities:

> *A lot of times, it's always the environment or natural resources departments [engaging with the CASC]. But what about like the health programs? What about the education programs? What about even the government level? Because as a tribe, it's all of these things versus just the environment and natural resources that climate change affects.* (Participant 01)

Although the TEP has previously engaged topics and tribal staff in some of these other areas, the organization does not currently have the capacity or expertise to fully integrate them into the core work of the program. The limited number of interviews we completed with other tribal staff suggests that these areas face some of the same challenges as environmental and natural resources departments but also differ in unique ways.

Some participants also suggested broadening engagement by devoting greater attention to Louisiana and Texas, where most of the Indigenous population does not belong to federally recognized tribes or lives outside of tribal jurisdictional boundaries:

> *Louisiana definitely needs more. I think [the South Central CASC has] done a really good job between Oklahoma and New Mexico. I think some of the hang ups when it comes to Louisiana is we just don't have a lot of federally recognized tribes.* (Participant 24)

The same participant explained that in Texas, Indigenous peoples are frequently misrecognized as non-Indigneous Mexicans but have deep roots in the region and continue to follow their ancestral migration routes back and forth across the border. Along with facing unique climate change and adaptation challenges, these groups without federal recognition also have fewer resources available to support adaptation work.

Second, multiple participants saw an opportunity for the TEP to broaden its outreach and communication to reach more tribes. Participants explained that although the CASC does great work, it is not well known among tribes or the public more generally:

> *A lot of people don't know that there's this climate center down at OU [University of Oklahoma]. You know, they really don't. I didn't for a long time and I've worked here forever… I think maybe they could do a little bit better, a little more outreach.* (Participant 25)

> *I think [the CASC as a whole] need to tell their story more. They're kind of hidden a little bit. They're known within their world, but their world is pretty small… [T]he work that they're doing is important and I just don't think very many people know about it.* (Participant 09)

Although participants appreciated the TEPs direct and personalized outreach, this finding suggests that the communication strategy could be broadened to reach more tribal departments and staff.

Lastly, participants raised concerns about the turnover and vacancy periods of some of the South Central CASC tribal liaison positions. The New Mexico tribal liaison position in particular has undergone significant turnover and remained vacant for most of 2023. Given that relationships form the foundation of tribal engagement work, participants saw greater stability and consistency within this position as important and noted that the instability likely interferes with relationship building in New Mexico. The importance of stability in this position was also evident in that nearly everyone we talked to identified South Central CASC with April Taylor, a CASC tribal liaison from 2012 to 2023. For many tribal staff, she represented not only the "face" of the center but of adaptation work more generally. Former South Central CASC tribal liaisons identified the position's low pay as the main reason for the high turnover:[3]

> *It's a very entry-level position… [A]t least at the time that I was there, it's not a position that you can raise a family on. It's not a high-paying position. But it's a very fulfilling position and it did give me great groundwork [for my current tribal adaptation work].* (Participant 20)

> *At least while I was at the [South Central] CASC, they needed to pay the tribal liaison more. It was really hard to replace me just because $33,000 [salary],[4] something like that, is hard for a lot of people to survive on.* (Participant 03)

On a more fundamental level, many of barriers to adaptation work that tribal staff encounter affect the TEP as well. Turnover, small staff size, and insecure funding sources all present barriers to expanding the services and reach of the program.

4 PEC RECOMMENDATIONS

In 2023, we facilitated two workshops with the Performance Evaluation Committee (PEC) and current South Central CASC employees to present and discuss the findings of the interview study (see 6.1 in the Appendix for more on the PEC). This section summarizes PEC recommendations for the TEP that emerged from workshop discussions. The recommendations do not address all concerns and challenges raised by participants but offer potential starting points based on the current capacity of the program.[5] Although the TEP has previously tried many of the ideas presented here over the course of its 11-year history, workshop participants agreed that continued experimentation is important given the shifting terrain of climate adaptation work, changes in tribal departments, and organizational learning of the

[3] The funding arrangement for tribal liaisons at the South Central CASC differs from the other CASCs. Currently, one South Central CASC tribal liaison is funded by the USGS on the South Central CASC host agreement. The other two tribal liaisons are OU employees funded through a BIA grant. Because of the different funding structures, compensation for the South Central CASC tribal liaisons has in some cases been significantly lower than the rest of the CASC tribal liaison network. This is particularly true of the tribal liaison responsible for New Mexico. The starting salary for the NM position has varied based on experience, but the position was originally designed to be entry level and with limited internal career mobility options.

[4] Adjusted for inflation, this salary would be approximately $42,000 in 2023 dollars.

[5] Workshop participants also recognized the implicit tradeoffs associated with recommendations given the infeasibility of implementing all the ideas. Determining priorities to decide which changes to pursue was left to internal South Central CASC discussions.

program itself. The PEC also stressed the importance of ongoing assessment of tribal needs across areas, recognizing that these needs are constantly evolving and not easily articulated by tribal staff. As such, a shared understanding of tribal needs emerges through interactions over time—once again, highlighting the foundational nature of relationships and relationship building to providing effective climate services for tribal communities.

Education. Discussions on educational opportunities centered on ideas for new training workshops and a mentoring program.

- Host training workshops on communicating climate change and adaptation to tribal leadership. The workshop would cover communication skills and provide an opportunity for tribal staff to practice communicating climate change topics.
- Create training workshops on climate monitoring that would include data collection in the field (similar to the recent harmful algae bloom training). Based on the interview findings, there would likely be strong interest in this type of workshop (data collection, hands-on, in the field), but it would take significant professional development on the part of TEP staff to develop.
- Two options were discussed for possible mentoring programs:
    - A cohort mentoring program where a small number of tribal staff meet on a regular basis (e.g., twice a month) and cover a common curriculum. This program would be more intensive than the current ad hoc training workshops but would also take significant time and energy to coordinate on the part of TEP staff. Maintaining buy in from participants over a longer timeframe would also be difficult.
    - A database tool that helps facilitate connections among tribal staff. The database would show skills, projects, and expertise of different tribes, as well as contact information for tribal staff willing to provide guidance on those topics. This option would be less intensive to organize and facilitate than a cohort program.

Research. Discussions on research opportunities centered on ways to make funding opportunities a better fit for tribal departments that would "meet tribes where they are."[6]

- Create research opportunities that contribute to capacity building. For example, requests for proposals (RFP) could include questions about training or data needs. If these needs appear too great to move forward with the proposal, the TEP can work with tribes to develop the capacity and reapply in the future.
- Provide multi-year research funding opportunities that will pay tribal staff for their time and expertise.
- Create opportunities for tribal staff to interact with successful research participants from previous years to learn more about research experiences and possibilities.

Communication and outreach. A wide range of opportunities were discussed for communication and outreach to expand the reach of the TEP.

- Devote a new position or half position to TEP communication and outreach. Communication and outreach is vital to the program, yet staff do not currently have the capacity to give the area the attention it deserves. Additional communications staff was seen as a high priority for increasing the overall capacity of the program.
- Clarify and better communicate the services that the South Central CASC can offer tribes. Clarifying services is particularly important for engaging tribes with less interaction or familiarity with the center. For needs that fall outside of the program's scope or capacity, develop a referral system to connect tribes with other services.
- Present to tribal leadership at regional and national inter-tribal organizations and committees for educational and outreach purposes. Presentations could be done in partnership with tribal staff to increase their confidence and skills in climate communication, while providing first-hand testimony on the benefits of CASC services.

[6] Some of these suggestions may fall outside the control of the TEP and South Central CASC to implement. We nonetheless include them as aspirational projects that committee members saw as potential pathways for increasing tribally relevant research.

- Tabling and outreach at conferences and events. These activities provide opportunities to see and meet staff from many tribes, offering a low-capacity strategy to build relationships and expand the program's reach. The only funding needed would be for travel and "swag" or interactive materials for tabling.

Expanding & leveraging partnerships. Workshop participants recognized the TEP's success in leveraging partnerships and discussed opportunities to continue serving tribal communities through collaborations.

- Partner to host larger events. Limited capacity in the TEP means that staff have not been able to hold larger events, like a tribal Climate Conference or weeklong camp. Workshop participants strongly valued and supported the overall strategy of the TEP, to hold smaller and more consistent events throughout the year rather than one or two big events. Leveraging partnerships would allow the TEP to continue smaller events on a regular basis while also participating in larger events, which would be too time-consuming and difficult to coordinate alone.
- Strengthen relationships and "cross-pollination" among tribal liaison positions in different organizations. Workshop participants recognized the CASC network of tribal liaisons as a unique, valuable, and successful model for engaging with tribal communities. Although some coordination and communication exist across CASC tribal liaisons and between CASC tribal liaisons and other federal tribal relations positions, continuing and strengthening this work was seen as a promising area of opportunity.
- Ensure the TEP's ability to connect tribes to agency staff who address areas of climate change that fall outside of the USGS mission areas (e.g., public health, transportation, agriculture). Workshop participants described the CASC tribal liaisons as in high demand because of the unique nature of the program among federal agencies. However, the TEP does not have the technical expertise or capacity to provide climate services in all areas. Rather, the TEP should encourage and support other agencies to develop their own tribal engagement programs.

Student interns. Evaluation of the student intern program was not part of the interview study but emerged as a topic of discussion because of the importance of youth engagement and intergenerational relationships to tribal communities. Workshop participants discussed ways to continue developing the student intern program and integrate student interns into different aspects of the TEP and research partnerships. Many of these ideas have been incorporated into the proposed part 3 of the evaluation plan (see Appendix section 6.2.2).

- Develop a standardized list of tasks and assignments for interns. Standardized (but flexible) assignments can reduce the time and energy needed to manage interns, while providing ways to more easily involve them in larger projects.
- Feature past students within communication and outreach products. A "student spotlight" feature can be used to follow up with students to see what they're doing now and if and how their experience with the South Central CASC has shaped their life and work.
- Create mentoring opportunities among past and current students and greater opportunities for students to work with local tribes.

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6 APPENDIX

6.1 INTERVIEW STUDY DATA & METHODS

6.1.1 Study design

The evaluation interview study was designed to address three main questions:

1) What climate adaptation challenges, priorities, and needs do tribal nations face in the South Central region?
2) How have tribal nations engaged with scientists, research, and data in their climate adaptation work?
3) How has the South Central CASC helped to address tribal climate adaptation challenges?

To answer these questions, we conducted in-depth, semi-structured interviews with people involved with tribal climate adaptation work in the south-central region (Louisiana, New Mexico, Oklahoma, and Texas).

Study outreach and recruitment occurred primarily through established networks of South Central CASC tribal liaison April Taylor. We selected potential participants based on their past or current involvement with the South Central CASC, location, position, and organizational size and type. Ms. Taylor used email outreach to extend the initial interview invitation and to connect contacts with the evaluation team but was not involved with the study beyond this initial outreach. We sent up to three follow-up emails if contacts did not respond to the initial outreach. "Snowball" sampling was also used to expand the sample to those without an existing connection to the SC CASC. At the end of each interview, we asked participants to recommend others who they thought would be important for us to interview.

Depending on participant preference, interviews were conducted either over the phone or virtually through Zoom and lasted about an hour. One interview occurred in-person at the Center for Applied Social Research. An interview guide provided suggested questions and probes, but interviews were conversational and flexible depending on participant interests and experiences. Dr. Bray conducted most (94%) of the interviews, with undergraduate research assistant Tiberius Hutchison conducting the remaining. Interviewers obtained participant consent verbally before each phone/Zoom interview or in writing for the in-person interview. Participants determined how they would be identified and how their interview data would be used in study products. Most participants opted for their identity to remain confidential, but two participants involved with the Case Study report agreed to be identified by name. Most participants also chose to review and approve any direct quotes prior to their being used in any study products. The option to review and approve direct quotes was added to the consent after the first several interviews because participants expressed uncertainty about confidentiality issues and how their data would be used.

The University of Oklahoma—Norman Campus Institutional Review Board reviewed and approved outreach and recruitment material, consent, and interview guide (IRB #14119).

Interviews were recorded and transcribed verbatim using an automated transcription software (NVivo Transcription) and then reviewed and corrected for accuracy. Transcripts were analyzed using NVivo qualitative analysis software. Transcripts were coded thematically based on common topics in the interviews, including climate challenges, barriers to climate adaptation work, engagement with climate services, and how that engagement had informed their work. Subsequent rounds of coding identified emergent themes within these categories. Because the study is qualitative, we do not quantify themes within our findings but, when appropriate, attempt to give the reader a sense of how common they were within the sample.

6.1.2 Participant characteristics and demographics

In total, we conducted 32 interviews with 33 participants (one interview had two participants) engaged in tribal climate adaptation work in the South Central CASC region. Most but not all participants were connected to the South Central CASC in some way. Participants worked for multiple types of organizations, including tribal staff who had used South Central CASC services (48.5%); organizational partners who collaborated with the TEP on services and events including government agencies, other scientific organizations, and non-profit/consulting organizations (30.3%);

academic/university researchers who engaged with tribal nations through research activities (21.2%); and current and former South Central CASC employees (18.2%, see Table 2). For organizational categories, we include participants' current and former affiliations to better capture the full range of experiences and because individuals often held roles with multiple organizations. As a result, the total sum to over 100%.

Table 2. Participant demographic and organizational information (N=33)

	N	%
Organization type[a]		
Tribal Nation	16	48.5
Partnering organizations	10	30.3
University/research	7	21.2
SC CASC	6	18.2
Race/Ethnicity		
Native (alone or in combination)	18	54.5
White	14	42.4
Multiple (non-Native)	1	3.0
Gender		
Women	19	57.6
Men	14	42.4
Location[b]		
Louisiana	2	12.5
New Mexico	5	31.2
Oklahoma	8	50.0
Texas	1	6.3

[a] Includes current and former organizations and sums to over 100%.
[b] Tribal staff only, N=16

Most tribal staff interviewed worked for tribes in New Mexico (31%) and Oklahoma (50%), reflecting the large number of tribal nations located within these states and where most of the work of the TEP has historically been concentrated. All tribal nations represented are federally recognized. Tribal staff worked primarily in environmental and natural resources departments. Although we talked to a few participants from other areas, such as fire management, transportation, and planning, the findings apply mostly to environment and natural resources departments. Just over half of all participants (53%) identified as Native or Indigenous, either alone or in combination with other races. 44% identified as white. 56% identified as women. Participant demographic and location information have been excluded from the report findings to preserve confidentiality.

6.1.3 Report review and feedback process

As described in more detail below (see Section 6.2), this evaluation study was designed in collaboration with a TEP Performance Evaluation Committee (PEC) composed of tribal staff, current and former South Central CASC employees, and other TEP partners. Following data collection, the evaluators and PEC reconvened in a day-long workshop in August 2023 to (1) present findings from the interview study, (2) elicit feedback on how to interpret and present findings, and (3) discuss opportunities and future directions for the TEP based on study findings.

The final report was drafted following the PEC workshop, then sent out to study participants and PEC members for review and feedback. A second PEC meeting occurred in December 2023 to discuss report feedback and revisions and continue conversations on the future of the TEP. Committee recommendations from both meetings have been incorporated into the final report (section 4). Feedback from both participants and committee members has also been integrated throughout the report.

6.2 EVALUATION STUDY BACKGROUND & PLAN

In 2018, the South Central Climate Adaptation Science Center (CASC) underwent a five-year external review [1]. The resulting report recognizes the accomplishments of the center's Tribal Engagement Program (TEP) and offers several recommendations for building on the program's existing strengths. Reviewers encouraged the program to:

- Evaluate how to shift tribal engagement from the start-up phase to long-term support, information distribution, education, and training.
- Continue efforts to identify activities that support tribal empowerment, planning, decision making, adaptation, and management and refine approaches to further strengthen tribal engagement.
- Develop a strategy for assessing tribal interests, concerns, and needs to determine an appropriate level of engagement and communication with potential stakeholders and partners.

- Continue building tribal technical capacity to work with climate data for use in vulnerability assessments and adaptation planning.
- Evaluate the success of developing tribal technical expertise for using climate data for tribal planning.

The emphasis on evaluation and assessment across multiple program areas highlights the need for a more integrated and comprehensive evaluative approach to continue strengthening the program's ability to support tribal partners.

In response to the external evaluation, the TEP convened a Program Evaluation Committee (PEC) in 2020, comprised of 18 members and including current and former CASC employees, tribal partners, and federal agency staff. The committee's purpose was to create an evaluation model and identify evaluation goals. Toward these ends, the committee produced a report in Summer 2021 that places Indigenous cultural values at the center of the evaluation process, including self-determination, intergenerational involvement, continuous cross-cultural education, and respect for Indigenous knowledges [2]. The report reflects the program's commitment to centering Indigenous voices and tribal priorities within its engagement strategy [3, 4] and stresses that any program evaluation should include "a long-term planning process with the tribes to identify common goals such as using climate planning to include cultural revitalization or strengthen the communities' resilience by teaching the community and letting them lead" [2].

Following the PEC report completion, South Central CASC contacted the Center for Applied Social Research (CASR) at the University of Oklahoma to further develop an evaluation plan based on the objectives and goals outlined by the PEC. Through a series of planning meetings during Fall 2021, the CASR team (Drs. Paul Spicer, Jack Friedman, and Laura Bray) worked with South Central CASC tribal liaisons April Taylor and Cynthia Naha and former South Central CASC director Kim Winton to define the TEP goals to be evaluated and determine appropriate methods. Importantly, both the PEC report and ongoing discussions between South Central CASC and CASR highlighted key tensions that may impede a successful evaluation, including:

- Overreliance on quantitative metrics that miss more qualitative measures of success.
- A singular focus on scientific outcomes that discount or ignore other important goals related to social justice, equity, and sovereignty.
- Devaluation of traditional ecological knowledge and Indigenous ways of knowing, including failure to recognize the spiritual and cultural components of Indigenous ecologies.
- Historical and ongoing settler colonial relations that diminish the capacity of tribal nations to participate as equals within research partnerships.
- Lack of knowledge on the part of non-Indigenous researchers of how to respectfully engage with tribal communities.

Given these tensions, the goal of the CASR team (all non-Indigenous social science researchers) was to help enact the vision of the PEC by (1) showcasing the accomplishments and value of the TEP, particularly those that may not be obvious to outside observers, (2) centering the voices of tribal partners to learn about their climate needs and challenges and (3) developing mechanisms to strengthen Indigenous values and priorities throughout the organization.

In August 2022, the OU team presented the resulting evaluation plan (see section 6.2.2) to the PEC for feedback and discussion and Bray agreed to lead the efforts. South Central CASC provided funding for Parts 1 and 2 of the plan, completed between Fall 2022 and Summer 2023. Implementation of Part 3 depends on future funding support and priorities of the South Central CASC.

6.2.1 Mission and organization of the South Central CASC Tribal Engagement Program

The South Central CASC Tribal Engagement Program (TEP) seeks to build relationships with tribal nations to better understand and meet their climate adaptation needs. This mission is accomplished through three primary program "arms": student internships and youth outreach, training and educational workshops, and research partnerships [2, 4]. Figure 2 presents a conceptual model illustrating how these three program components work together. Notably, each

arm forms an integral part of the program that cannot be detached from the whole without impairing the tribal engagement mission.

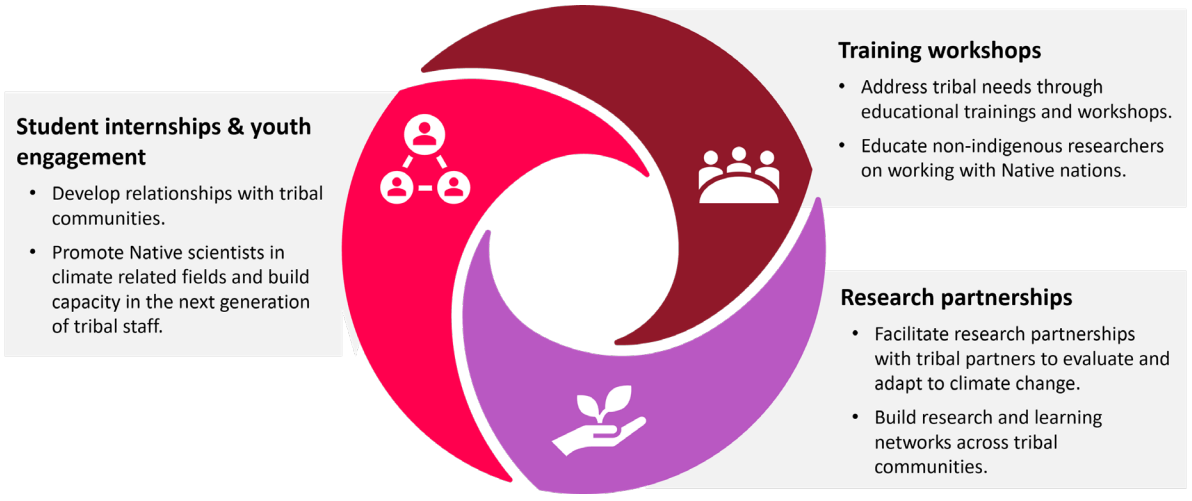


Figure 2. Conceptual model of the South Central CASC Tribal Engagement Program

Reflecting the organizational mission of the CASCs, the objectives of each arm of the Tribal Engagement Program center on *relationship* and *capacity building. Training workshops* assist tribal professionals in gaining foundational climate knowledge and prepare non-Indigenous researchers to engage respectfully with tribal nations. More advanced training workshops also serve the dual purpose of identifying tribal research needs and adapting/translating research products into tools that are practical and appropriate for tribal nations. As such, training workshops play a crucial role in aligning climate research with tribal needs and communicating research findings and products back to tribal partners. Training workshops are also critical to establishing and maintaining relationships with tribal partners by providing an entry point to engaging with climate science that meets their current knowledge level and capacity.

Research partnerships seek to facilitate climate research that serves the needs of tribal nations and involves tribal partners as co-investigators or advisors. Projects should aim to co-produce actionable knowledge for tribes and guide greater resources (e.g., financial, educational, etc.) into tribal communities. In the long-term, the TEP hopes to increase the number of research projects led by tribal partners and facilitate greater research collaborations among tribal partners. That is, in addition to knowledge co-production, the program seeks to build climate research and learning networks across tribal communities.

Finally, *student internships* integrate undergraduate students into tribal engagement work through research participation and supporting tribal climate services. *Youth engagement* focuses on exposing Indigenous youth to adaptation science and careers through summer programs. These programs help to facilitate intergenerational involvement, something important to tribal partners, as well as providing greater pathways for underrepresented Indigenous students into climate and adaptation careers.

6.2.2 OU evaluation plan

Discussions between the CASR evaluation team and South Central CASC evaluation committee resulted in a three-part plan for evaluating the Tribal Engagement Program that included: (1) a case study, (2) interview study, and (3) development of internal assessment and improvement mechanisms (see Figure 3).

Step 1: Case study to evaluate the long-term impacts of the TEP

To evaluate the long-term impacts of the Tribal Engagement Program, we conducted a case study to explore how tribal partners have applied climate knowledge following engagement with South Central CASC. The case study provides insight into how participants have used knowledge gained through climate training workshops and how engagement has contributed to tribal adaptive capacity, as well as other outcomes important to tribal communities. The case study was completed in November 2022 and focuses on the New Mexico Tribal Resilience Action Network (NM TRAN), an

initiative that emerged out of a South Central CASC grant writing workshop [5]. At the time of the report, we had completed 15 total interviews, four of which were with people involved with NM TRAN. The report explores one example of "success," and previews themes that are expanded on in the interview study.

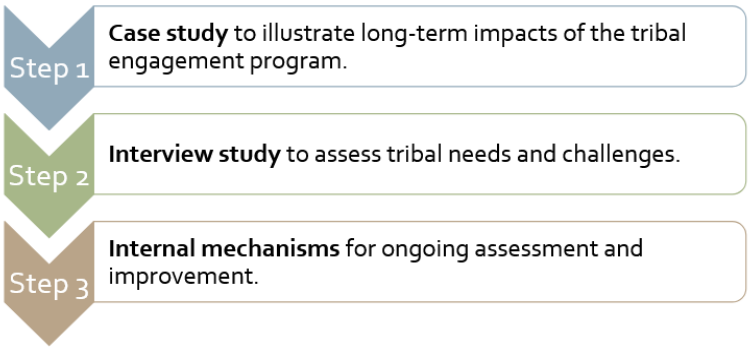


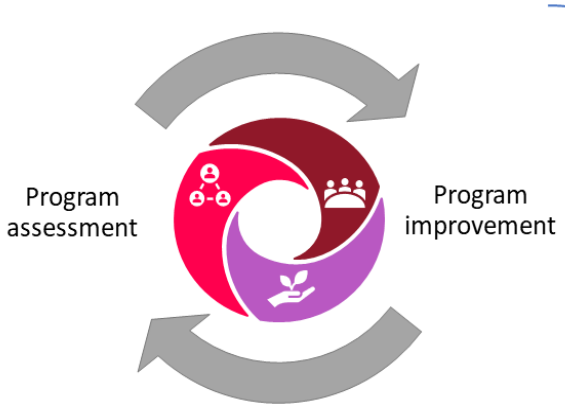
Figure 3. Visual summary of the South Central CASC Tribal Engagement Program evaluation plan.

Step 2: Interview study to assess tribal needs and challenges related to climate change and adaptation

Following the case study, we expanded the study to include a broader range of tribal environmental professionals and others involved with tribal climate adaptation throughout the South Central CASC region. As described above, we interviewed 33 participants, including tribal partners who have previously engaged with South Central CASC as well as those with no previous relationship. In-depth semi-structured interviews examined tribal partners' experience with the CASC (if applicable), as well as broader challenges related to climate change and adaptation. The results of the study will allow the CASC to better tailor its programs to meet the needs and priorities of tribal communities, including developing new training programs and advising researchers on the topics and resources most of interest to tribal partners. The findings can also inform the design of internal mechanisms for ongoing assessment and improvement of the Tribal Engagement Program (step 3).

Step 3: Internal mechanisms for ongoing program assessment and improvement

The final component of our evaluation plan involves implementing mechanisms for ongoing assessment of the three arms of the TEP. Parts 1-2 provide a foundation for understanding tribal priorities, challenges, and needs but only offer a snapshot. Creating sustainable and ongoing processes for gathering feedback from tribal partners and participants will ensure that the TEP evolves along with the needs of tribal communities. Initial ideas for Step 3 include two components: (1) collecting qualitative feedback from tribal partners and others served by the TEP on a regular basis, with student interns leading the data collection efforts, and (2) developing and tracking quantitative metrics to measure outcomes across the three project arms.



Program arm	Assessment and improvement mechanisms
Student internship	Exit interviews with student interns; Follow up interviews with past students.
Training workshops	Outreach before and after workshops to understand tribal needs and if they're being met; Talking Circle at the end of training.
Research partnerships	Follow up interviews with tribal staff and researchers to understand what worked better and less well about the partnerships.

Figure 4. Potential mechanisms for ongoing program assessment and improvement

The qualitative component of the ongoing program assessment and improvement would focus on understanding tribal partners' experiences and needs on an ongoing basis, for example through pre- and post-training outreach to check in with participants or follow-up interviews with tribal staff involved in research following project completion (see Figure 4). We envision that much of this work could include TEP student interns, which would provide them with the opportunity to develop social science research skills and connect with tribal partners and past student interns. The

qualitative component would also include exit interviews with student interns, as well as outreach and follow-up interviews with past student interns to learn about their personal and career trajectories since leaving the South Central CASC and how their internship experience may have influenced their path.

The quantitative component of ongoing assessment would develop and track metrics to measure program goals and progress over time. Some systems are already in place, such as collecting regular survey feedback on training workshops, but are not systematically tracked and analyzed over time. In other areas, no system currently exists to collect and analyze data. Based on early conversations on the needs and ideas in this area, Table 2 provides an overview of outcomes and potential metrics associated with each program arm. As described above, each arm has a capacity and relationship building component, with metrics designed to assess each of these areas. We emphasize that these are *potential* metrics and recognize that quantifying outcomes may not always be suitable, appropriate, or desirable.

Table 3. Objectives and potential metrics for the South Central CASC Tribal Engagement Program

Program arms	**Relationship building**		**Capacity building**	
	Objectives	Metrics	Objectives	Metrics
Student internships & youth outreach	Establish mentoring relationships between students, their peers, tribal partners, and researchers	Number of students served, and mentoring relationships established	Understand the importance of climate knowledge for diverse professional/career paths	Number of students who anticipate using climate knowledge in their future career.
Training workshops	Establish and maintain relationships with tribal partners	Number of tribes reached through trainings; new tribal partners engaged	Increase knowledge and awareness of climate science; Translate and adapt climate science to meet the needs of tribal communities; Translate tribal needs into research agendas	Number of climate adaptation/mitigation plans created, or integrated into other plans
Research partnerships	Establish and enhance research partnerships with and between tribal partners	Number of research projects with tribal partners (including with university researchers, other tribes, non-governmental organizations, etc.)	Co-produce actionable knowledge for tribes; Increase financial resources to support tribal citizen/student researchers	Number of grants and research reports; Number of tribal citizens and student interns employed through research partnerships

6.2.3 References

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6.3 CASE STUDY REPORT

Tribal Engagement in Climate Services:
A Case Study of the New Mexico Tribal Resilience Action Network

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As the climate crisis accelerates, so does the urgency of producing science that can support what Kyle Whyte calls "tribal collective continuance," or communities' capacity to adapt and flourish within a changing climate [1, 2]. Making climate knowledge "actionable" has become a central mission for many climate service organizations, yet how to best accomplish this task remains an open and pressing question [3, 4]. For Indigenous nations and peoples, histories of exploitative research practices, ongoing colonization, and resource limitations further complicate the challenges of actionable climate science. Given these challenges, how can climate service organizations best support tribal adaptive capacity?

As part of an evaluation study undertaken by the South Central Climate Adaptation Science Center (South Central CASC) Tribal Engagement Program, we're interviewing tribal staff and others working in tribal climate adaptation throughout the South Central region (Louisiana, New Mexico, Oklahoma, and Texas), with the goal to: (1) better understand if and how engagement with the SC CASC has translated into increased adaptive capacity for tribal communities and (2) assess tribal needs and challenges related to climate change adaptation. To date, we've talked to 15 people, including tribal staff, former and current South Central CASC employees, and researchers/practitioners with federal agencies and grassroots organizations. Four of the interviews focused specifically on the New Mexico Tribal Resilience Action Network (NM TRAN), an initiative that emerged following engagement with the South Central CASC to continue tribal climate adaptation work in New Mexico. We use the NM TRAN as a case study to illustrate preliminary themes emerging from the interviews, demonstrate one pathway through which the Tribal Engagement Program has positively impacted tribal resilience, and identify lessons that could be applied within other tribal communities throughout the region.

Developing climate leaders and technical capacity

Cynthia Naha has been described as an "incredible powerhouse" and one of the most "relevant [people working in] the tribal adaptation space in New Mexico." Yet Cynthia is more likely to tell you that she's "just a rez girl" who only five years ago felt completely overwhelmed by climate science. Her dive into the world of climate science and adaptation began in 2016 when, as the Director of the Natural Resources Department for the Santo Domingo Pueblo in New Mexico, she inherited a BIA Tribal Climate Resilience Program grant to support the development a climate adaptation plan. Originally, the grant had consultants receiving most of the money and doing most of the work, but Cynthia wanted to take a more active role. While sometimes necessary, she explained that consultants tend to be outsiders, and few take the time to truly understand the community. Without that community connection, you could spend "thousands of dollars on a plan that is going nowhere because it's not relatable to your people." She believed that, with the right training and resources, tribal staff could do it better.

Historically, Indigenous peoples adapted to environmental and climatic change through a combination of scientific, cultural, and political practices. Tribal communities continue to apply traditional knowledge and practices to adapt but must now do so under conditions of political and economic marginalization and unprecedented ecological disruption. Within this context, "Western" science can complement traditional knowledge systems to help communities understand and respond to environmental change [5]. Yet Western climate science often remains inaccessible to tribal communities. Tribal nations vary widely in their governance structures, land base, technical capacity, population size, and financial resources, all of which affect how they respond to climate threats [6, 7]. Reservation lands held in trust by the federal government cannot be taxed, leaving tribal administrative bodies with limited funding options. As a result, many tribal environmental and natural resources departments rely on small staff sizes and external grant funding to operate. And even the best resourced tribes must balance climate adaptation with multiple other pressing priorities.

For tribal staff interested in incorporating climate science into their work, gaining a basic understanding of climate change represents only the first of many hurdles.

If Cynthia was going to oversee the planning process, she first needed to educate herself. So, she connected with the South Central CASC, among other organizations, and began going to climate trainings and workshops. At first nothing seemed to stick, and she struggled to see how the information could help the tribe.

> *When you're sitting in the class and you're not experienced with this…and they're showing all the projections…And you're all like, "Well, what does this all mean to me? And how am I supposed to take what you're showing me back to my leadership, back to my tribal members and explain [to them], this is climate change?"*

But she was determined and kept coming back. Still, it would take almost two years before everything really began to make sense. She attributes her eventual success to a few different things, one being sheer tenacity to overcome the inevitable frustrations and setbacks that come with developing expertise in a new area. As Cynthia described it, the process required "build[ing] my own capacity, identifying my own trainings to attend" and falling "into the climate change rabbit hole." The relationships she was building in the process would ultimately pull her out of this rabbit hole.

Everyone I've talked to has emphasized the importance of South Central CASC's workshops and gatherings for relationship building. Referencing the critical pedagogy of Paulo Freire [8], one participant described the learning that takes place through the South Central CASC as relational. Learning happens in interaction and community with others and cannot be reduced to a one-way transfer of knowledge. This idea is particularly true when placing Western science in dialogue with experiential and place-based Indigenous knowledges. For Cynthia, the long-term relationships formed during workshops and gatherings proved crucial for making climate science accessible. The data is now "just a click away" because she can call Renee (University Director) or Derek (Research Scientist) or April (Tribal Liaison) or Mike (USGS Deputy Director) when she needs help understanding and digesting the information. Relationships also formed horizontally as Cynthia connected with others in the tribal adaptation space and began having deeper conversations about what the science means for New Mexico specifically.

When we spoke, Cynthia moved easily between climate science and data, local environmental change, and her work as tribal environmental professional building greater resiliency. This ability to traverse Western and Indigenous knowledge systems and communicate climate science in a way that's meaningful to tribal communities reflects a rare and hard-earned skill. Cynthia now represents a prominent voice in climate adaptation not only in New Mexico but nationally. Now, she said, the tables have turned. People are knocking on her door, asking for her opinion. She credits much of this success to the South Central CASC.

> *I honestly feel [that] if I didn't…have the connection that I had with South Central [CASC], I probably would still be like, "Well, what does this all mean?"*

But beyond her personal success and ability to enact the Pueblo's climate adaptation plan, the South Central CASC was also instrumental in founding NM TRAN, an organization that is working to diffuse adaptation knowledge more broadly and break down many of the barriers that Cynthia encountered doing climate adaptation work.

Institutional barriers to climate action

Atherton (Atty) Phleger has gained a broad perspective of tribal adaptation work in New Mexico through his former work as a South Central CASC tribal liaison and current position with Flower Hill Institute, a Native-owned nonprofit that supports tribal climate action among other community development projects. If Cynthia's story highlights the challenges in developing technical knowledge for climate action, Atty's underscores the institutional barriers that can derail climate adaptation projects in tribal communities. Oftentimes, he said, these barriers are not what you might expect.

> *What I realized early on is that the things that will prevent adaptation projects from happening are almost never the ones that you think they are.*

The "big" things of course matter. As Cynthia pointed out, tribes may not even begin thinking about climate adaptation until they receive a grant. But Atty frequently observed seemingly minor hang ups thwarting entire projects. He offered examples ranging from someone missing an important meeting to the inability to find somewhere to host an event.

Atty saw his job as tribal liaison to precisely identify and address these sticking points. This work might mean making a simple phone call or finding $500 in flexible funds to cover rental space or food. Yet the fact that minor obstacles could impede climate action speaks to a larger issue that emerged across multiple interviews: the conventional climate adaptation model simply does not work well for many tribes.

The typical planning process begins with a vulnerability assessment, followed by an adaptation plan, and then finally, assuming all the pieces fall into place, implementation. The entire process can cost millions of dollars and take a decade or longer to complete. Like Cynthia, other environmental and natural resources managers said they felt intimidated by the process and struggled to figure out how and where to start. The process also presents lots of opportunities for something routine, like changes in staffing or leadership, to disrupt projects. Because of this, Atty said he has become "increasingly skeptical" that the planning process fits many tribal communities. The fit of course depends on the community in question. Tribes with greater capacity and further along in their adaptation efforts tend to report fewer struggles and greater appreciation for the conventional planning model. But many tribal staff, particularly in the early stages of this work, say they would prefer an alternative entry point.

Part of the mismatch between tribal needs and prevailing models stems from the complexity and scale of actions. The planning process relies on in-depth technical data to create a comprehensive view of community vulnerabilities and propose solutions across a variety of areas—transportation, health, housing, water resources, agriculture, recreation, etc. Sometimes though, the more simple and straightforward actions can be just as, if not more, effective. One natural resources manager described her frustration with how their vulnerability assessment played out:

> *[W]e didn't have the staff, the support, the money, the capacity. We didn't have the ability to do a vulnerability assessment that would impact the way that we're working…We realized that kind of planning was [telling] us to just do what we already were doing.*

Although valuable in other respects, the in-depth data collected during the vulnerability assessment seemed to contribute little to increasing overall tribal resilience. Atty agreed. In his experience, "the best examples of actual adaptation measures are often not coincidental with the communities that have really sophisticated adaptation plans."

> *I feel like [the need is] much less about the science, much less about the planning and much more about the actual nitty gritty. How do you actually do the thing that you know that they're going to have to do eventually?*

How you actually "do the thing" is by placing tools directly in the hands of those responsible for implementation.

The best attended workshops that Atty organized as a tribal liaison addressed soil health and erosion control. Previous workshops tended to engage the same core group of people, usually environmental and natural resources staff at the director level. This time, the entire agricultural department from six different tribes showed up. Rangeland managers showed up. Water quality technicians showed up. His idea was to provide a "new pathway directly to implementation" by targeting problems common to tribes in the region. Soil health is always vital but even more so for agriculturalists under conditions of increasing water scarcity. Rather than just discussing climate projections and impacts, the workshops offered practical strategies that could be implemented immediately. They spent part of one day, for example, in the field fixing an erosion gully. Building rock dams isn't exactly cutting-edge science. But these types of low-tech, low-cost adaptation strategies offer an accessible and much needed complement to the planning process. Yet these types of strategies, Atty said, rarely receive support from the big climate institutions and funding sources, which tend to prioritize the "big and fancy" approaches.

Designing adaptation strategies for Indigenous communities

Recognizing that existing institutional frameworks are ill-suited for many tribal communities leaves two options: adapt existing models to Indigenous contexts or innovate new ones. The New Mexico Tribal Resilience Action Network (NM TRAN) illustrates the latter path. Cynthia, who currently serves as the chair of NM TRAN, described how the organization emerged from conversations and connections made through South Central CASC events.

> *[W]e took it upon ourselves as technical staff to really figure out, "OK, well, we're learning more about this information that the CASC is presenting…How do we break this down so our communities can better understand?"*

The organization thus formed as a way for tribal staff to collectively make sense of climate science, translate it for local communities and contexts, and learn from each other.

The existence of a regional intertribal climate organization alone is significant and requires substantial work. Cynthia and other tribal staff form the committed core of NM TRAN, but they also needed someone to do all the behind-the-scenes labor that holds organizations together—sending emails, reserving space, scheduling meetings, taking notes. As Atty put it, "everything other than having the idea." Extra time for these types of tasks simply does not exist for most tribal staff. The flexibility of the tribal liaison position allowed Atty to provide administrative and facilitative support to help sustain the organization, a role he continues to fill through the Flower Hill Institute. This help allowed Cynthia and the other NM TRAN members to focus on the big ideas that will make a lasting difference in tribal adaptation and resilience.

Early NM TRAN meetings focused on the basics, like figuring out how to talk about climate change and tribal resilience and sharing adaptation progress. These conversations then led to organizing workshops on local issues to pass on the information learned through their collective experience and previous trainings. Both Cynthia and Atty told me that their ultimate goal is to help create a "community of practice" where climate action becomes the norm for tribes across the state. This outcome would mean less reliance on the "big and fancy" projects and greater integration of climate action into the daily work of tribal staff and leaders across different spheres. Rangeland managers and transportation planners would no longer ask, "What does this have to do with me?" but would have an intuitive understanding of how to weave climate resilience into their work. Cynthia came by this intuition the hard way. NM TRAN offers an easier pathway to developing climate intuition through collaboration, peer learning, and mentoring.

The action orientation of NM TRAN also sets it apart. As explained by one member, the emphasis is "not just what's going to happen and how do we plan for it, but what projects are happening on the ground that tribes can learn from each other about." Towards this end, NM TRAN recently applied for and received a grant to build a Southwest Tribal Adaptation Climate Menu, modeled off a similar menu created by tribes in the Great Lakes region [9]. Similar to Atty's idea of a more direct pathway to implementation, the menu will offer adaptation strategies and actions targeting region-wide problems. The natural resources manager who was frustrated with their vulnerability assessment explained how the menu would have helped them.

> *[I]t's really addressing the problem that we had…which is that adaptation plans take too much time and effort. Creating one that anyone can sort of plug and chug…with our specific climate information, that's a helpful thing… [I]t gives people a place to start that they can trust, rather than just trying to come up with all that on their own.*

The climate adaptation menu will provide an alternative entry point into climate action that accounts for the time and resource constraints common to many tribal contexts.

Tribal staff in states without similar organizational infrastructure underscored the value of NM TRAN. The environmental director for one Oklahoma tribe told me that he had little knowledge of the tribal climate adaptation work happening across the state and wished for a state-wide organization to better facilitate communication and collaboration. Tribal staff in Louisiana talked about their struggles starting the planning process and desire for more intensive mentoring opportunities. Because of the wide variation in climate and environmental conditions across the region, and given the many barriers to greater climate action, developing more localized networks like NM TRAN that bring together tribes, practitioners, and researchers presents a promising avenue for promoting greater resilience.

Lessons for climate service organizations

The case of NM TRAN offers several lessons for the South Central CASC and other climate service organizations interested in supporting great tribal adaptive capacity. First, the technical skills and knowledge taught at training workshops are important for developing climate leaders. Cynthia's story may not be typical. More likely, relatively few will replicate her path and gain the same depth and breadth of climate knowledge from attending training workshops. But some will. And those few can become important catalysts for diffusing climate knowledge and action within their communities, amplifying the reach and impact of these training programs.

Second, relationships provide the foundation for learning. That successful partnerships with tribal communities require long-term relationships built on trust should go without saying. But more than simply enabling partnerships, relationships are indispensable for learning itself. Recognizing that we think and learn collectively further underscores the importance of workshops and other gatherings for creating a shared understanding of the climate problem, evaluating the appropriateness of existing solutions, and innovating new ones.

Third, administrative and organizational support builds adaptive capacity by allowing tribal staff to focus on climate action. For many tribal communities, adaptation work remains in its infancy, making it precarious and contingent on any number of situational factors. Given the time and resource constraints experienced by many tribal staff, the ability of the South Central CASC to offer administrative and organizational support for emergent projects and groups helps to fill in gaps that might otherwise prove fatal to adaptation efforts.

Fourth, identifying adaptation approaches better suited to tribal contexts can help to improve support services. The adaptation approach taken by NM TRAN represents only one potential alternative to the conventional planning process. Identifying and exploring other options, along with gaining a better understanding of the benefits and challenges associated with the conventional model, can help the South Central CASC and other climate service organizations tailor their services to the different needs of tribal communities.

Finally, organizational infrastructure represents a crucial element for making climate science actionable on a broad scale. Groups like NM TRAN provide the organizational structure required for the widespread adoption and use of climate tools and knowledge. The climate adaptation menu, for instance, will be meaningful not only because it is being "co-produced" with the end users but because NM TRAN exists to nurture a culture conducive to the technologies' use and teach the requisite skills. For climate service organizations, paying attention to these organizational dynamics can broaden their understanding of what makes science actionable and suggest ways to continue promoting the development and work of these vital organizations.

Ethics approval

This research was approved by the University of Oklahoma Norman Campus Institutional Review Board (IRB #14119).

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