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Enhancing Indigenous food sovereignty: A five-year collaborative tribal-university research and extension project in California and Oregon

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Abstract

A long history of tribal disenfranchisement through government policies has contributed to a lack of trust and participation by tribal communities in nontribal organizations and initiatives. This article will discuss the process through which new partnerships were forged using a community-based participatory research (CBPR) approach among university researchers, local nontribal organizations, and three Tribes in the Klamath River Basin of southern Oregon and northern California through a five-year federal food security grant. The partnership's shared goal was to enhance tribal health and food security and food sovereignty in the Klamath River Basin by building a healthy, sustainable, and culturally relevant food system. We describe the context that gave rise to this collaborative partnership; share reflections on how project

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goals, objectives, and activities were co-created, adapted, and implemented; and highlight specific examples of research, education, and extension activities, informed by CBPR, that support the tribal goals of strengthening Indigenous food sovereignty. We also share lessons learned from navigating unforeseen challenges in ways that we hope can provide insight for scholars, cooperative extension advisors, nonprofit organizations, and government agencies seeking to build effective partnerships with tribes working toward food system change in Native American communities.

Keywords
Native American, Food Security, Native Foods, Food Sovereignty, Indigenous Knowledge, Karuk Tribe, Yurok Tribe, Klamath Tribes, Traditional Ecological Knowledge, Community-Based Participatory Research

Introduction

> Our food not only nourishes our hearts, minds, bodies and spirits, it keeps us connected to our culture. To know a culture is to know the food. In the words of Winona LaDuke, "Our people can't recover until we recover our foods."
>
> —Perri McDaniel, Klamath Tribes Food Security Coordinator

Native American communities across the United States are experiencing some of the highest rates of poverty, food insecurity, and diet-related diseases in the country (Jernigan, Hyser, Valdes, & Simonds, 2017; Tomayko et al., 2017). Research has only recently begun to unveil the devastating and enduring impact of settler colonial policies enacted by the U.S. government against Indigenous people, including forced removal from the land, cultural assimilation, and mismanagement of Native ancestral lands, and their effects on the health and well-being of Native peoples (Hoover, 2017; Norgaard, 2014; Sowerwine, Mucioki, Sarna-Wojcicki, & Hillman, 2019; Turner & Turner, 2008). This long history of tribal disenfranchisement through government policies has contributed to a lack of trust and participation by tribal communities in nontribal organizations and initiatives. Many Native people seeking to revitalize their food systems consider restoration of traditional foods and practices essential to regaining their health, traditional economy and culture (Bell Sheeter, 2004; Conti, 2006; Jack, 1916). Yet challenges remain, due to limited funding and tribal capacity, gaps in knowledge caused by genocide, forced assimilation and associated historical trauma, limited access to ancestral tribal lands, and the inherent institutional power asymmetries shaping resource access, use, and management.

The Klamath River Basin of Oregon and California, with its Indigenous peoples—the Karuk, Yurok, and Klamath Tribes—is no exception. In 2007, a group of researchers from the University of California at Berkeley (UC Berkeley) and Karuk Tribal leaders and allies founded the Karuk-UC Berkeley Collaborative (2019) with the goal of building connections between the Karuk Tribe and UC Berkeley to support tribal-led eco-cultural revitalization initiatives. After several years of learning and discussion, in 2012 a team of researchers, the three tribes, a local nonprofit, the U. S. Forest Service, and the University of California Cooperative Extension came together with a shared vision to leverage the strengths of both Indigenous and Western science to conduct research, education, and extension to restore Native foodways in the Klamath Basin.[1] With funding from the U.S. Department of Agriculture (USDA) Agriculture and Food Research Initiative (AFRI) Food Security Program, the team embarked on a five-year, US$4 million collaborative research, education, and extension project, titled "Enhancing tribal health and food security in the Klamath River Basin by building a sustainable regional food system."

The overarching goal of the project was to create a more sustainable food system in the

[1] The PIs included UC Berkeley, the Karuk Tribe, the Yurok and Klamath Tribes, Mid-Klamath Watershed Council, and UC Cooperative Extension Humboldt/Del Norte Counties. Additional collaborators included the U.S. Forest Service, UC Davis, and College of the Redwoods.

Klamath River Basin, resulting in healthier communities, ecosystems, and economies among the Klamath, Karuk, and Yurok Tribes spanning from the town of Klamath near the Pacific Ocean in Northern California to the towns of Chiloquin and Klamath Falls in South Central Oregon. Project goals and objectives were identified through in-person community and partner meetings and phone calls over the course of a year leading up to the grant application, and traditional food revitalization emerged as a priority—central to decolonization, ecosystem management, community health, cultural identity, and youth empowerment. Through its focus on Native/traditional foods,[2] this project sheds light on specific food security concerns unique to the Klamath Basin Native American community, including access to, availability and consumption of native foods, and the knowledge, relationships and cultural stewardship practices that sustain them. It is important to note that while we frame our project around the concept of food security, in order to be in conversation with and evaluate the efficacy of national models for assessing and responding to Native American food insecurity, our work is motivated by and rooted within an Indigenous food sovereignty framework. Indigenous food sovereignty, "refers to a re-connection to land-based food and political systems" (Martens, Cidro, Hart, & McLachan, 2016, p. 18) and seeks to uphold "sacred responsibilities to nurture healthy, interdependent relationships with the land, plants, and animals that provide us with our food" (Morrison, 2011, p. 100).

Using a community-based participatory approach (CBPR), this project sought to (1) assess the historical and existing food systems within the Klamath basin, including traditional, contemporary and commodity food systems, from production and land management through consumption, with particular emphasis on policy barriers and enablers of a healthy food system; and (2) build capacity of local partners and community members through education, extension, and local and tribal-designed projects. Forty-three research, education, extension/outreach, and management objectives were developed, which ranged from research on traditional foods and Native food security to youth camps, traditional food workshops, food-related skill building, and the creation of a regional food security library, tribal herbaria, and tribal kindergarten through twelfth grade (K-12) curriculum. In this article, we provide an overview of the principles and approach that guide our collaboration, followed by a discussion of several key aspects of our project that illustrate how to translate such principles into action, including the development of tribal research protocols and intellectual property (IP) rights documents; the integration of native foods into a community food security assessment across the Klamath River Basin; the intersection of Indigenous knowledge (IK) and Western science in native food and fire ecology research; the creation of a Native food system curriculum; the establishment of tribal herbaria, repositories of culturally important plants for education and research; the founding of the Píkyav Field Institute, a tribal-led research, education, and workforce development institute; and the integration of cultural values into extension through workshops and seasonal food camps. These examples provides insight into various strategies for revitalizing and protecting Indigenous knowledge, plants, and landscapes, integrating cultural values into community food security research and extension, and strengthening institutional capacity for ongoing food security and food sovereignty work beyond the end of the grant.

Engaging tribes centrally in the design, implementation, and evaluation of the food security project strengthened project relationships, impacts, sustainability of programs, and tribal self-determination. Yet it was not without challenges. We describe the context which gave rise to this collaborative partnership, share reflections on how

[2] In the literature, traditional and Native foods are often used interchangeably. For the purposes of this article, we refer to cultural foods that are party of an Indigenous community's food heritage as Native foods. We intentionally capitalize Native and Indigenous throughout the paper when it refers to a particular people in the same way that African American and other ethnic labels are capitalized. When referring to the plants and animals that compose the foods themselves, we do not capitalize in that case, as in native foods security, or the state of having access at all times to the plants and animals that compose a "traditional" diet.

project goals, objectives, and activities were co-created, adapted and implemented, and highlight specific examples of research, education, and extension activities, informed by CBPR, that support tribal goals of strengthening Indigenous food sovereignty. We also share some of the challenges and lessons learned that we hope can provide insight for scholars, Cooperative Extension advisors, nonprofit organizations, and government agencies seeking to build effective partnerships with Tribes working toward positive food system change in Native American communities.

Background and Context

The Klamath River Basin is home to some of the largest tribes in California and Oregon.[3] Until relatively recently, the Karuk, Yurok, and Klamath Tribes had access to some of the richest natural resources of any tribes in the northwest U.S. (Chiu, 2008), with an abundance of nutritious, traditional foods such as salmon, deer, elk, acorns, mushrooms, and berries that were consumed fresh and dried, smoked, and canned, and that were shared with families up and down the river (Bell, 1991; Davis & Hendryx, 1991; Salter, 2003). As Euro-American immigrants arrived in the Klamath Basin, homestead gardens also became an important source of fresh vegetables and fruits.

Today, however, the entire region is classified as a food desert (U.S. Department of Agriculture, 2017).[4] Tribal populations and rural communities in the Klamath are among the poorest and most food insecure in the country (Jernigan, Garroutte, Krantz, & Buchwald, 2013; O'Donnell-King & Newell-Ching, 2017; Sowerwine et al., 2019; Stubblefield, Steinberg, Ollar, Ybarra, & Steward, 2011; Subramanian, 2011). Many once-vibrant orchards and home gardens have been all but abandoned, and grocery stores are few and far between. Farms in the Mid-Klamath region export most of their produce to the urban core, while community members, especially elders and the structurally poor, remain hungry. Our recent study found that nearly 92% of Native American households in the Basin suffer from some level of food insecurity, and over half experience very low food security (e.g., reducing size of meals and skipping meals) (Sowerwine et al., 2019). These numbers represent much higher rates of food insecurity among Native American populations compared with the national average (12%), and more than ten times the national rate of *very low* food security. Similarly, the poverty rate among Native American households in the Basin (42.74%) is three times the national average (Sowerwine et al., 2019).

Dramatic changes to the Klamath River basin and its forests and fisheries under settler colonialism, including hydraulic mining, clear-cut logging and fire suppression, constructing seven hydroelectric dams, commercial fishing, and extensive irrigated farming in the Upper Klamath have pushed salmon numbers to near extinction and altered regional ecosystems, depriving tribal members access to culturally important traditional foods. Post–World War II logging and the expansion of private and government ownership in the watershed drastically reduced traditional stewardship of forested landscapes for foods (Anderson, 2005; Chiu, 2008). State- sanctioned genocide in the late 1800s (Madley, 2016), followed by years of forced cultural assimilation, have further disrupted traditional food systems.

Traditional diets, once dependent on physical activities related to hunting and gathering, were replaced by a modern diet of highly processed, low-fiber commodity and store-bought foods, and a decrease in physical activity (Anderson, 2007; Bell-Sheeter, 2004; Grant, 2001; Mucioki, Sowerwine, & Sarna-Wojcicki, 2018; NRCS, 2011). Tribal members today have some of the highest rates in the U.S. of diabetes and other diet-related diseases (Jackson, 2005; Karuk Tribe, 2010; Norgaard, 2004; Subramanian, 2011), consistent with studies that show that decreased consumption of traditional foods is related to increased rates of diabetes and other diet-related diseases in Native Americans (Conti, 2006; Kuhnlein, Receveur, Soueida, & Egeland, 2004).

[3] Current tribal enrollment numbers for tribes that participated in the project are Karuk, 3,626; Yurok, 5,706; Klamath Tribes, 3,700.
[4] The USDA Economic Research Service created what was then called the Food Desert Locator, which has recently been changed and updated and is now called The Food Access Research Atlas (USDA, 2017a).

Despite these challenges, tribes in the Klamath Basin have retained much of the wisdom and practices associated with traditional food gathering and traditional land management, such as prescribed burning, that have sustained their populations and spiritual connection to the world around them for thousands of years. This tribal food security project sought to help our tribal partners revitalize these traditions and contribute to the growing body of knowledge on the role of prescribed fire management in enhancing the productivity of native foods and fibers while reducing catastrophic wildfires and associated hazards to human health (Lake et al., 2017). Efforts to understand the ecological processes that underlie Indigenous management of traditional resources sought to help bridge the gap between traditional ecological knowledge and Western science, increase the availability of nutritious traditional foods to Native groups (e.g., acorns and huckleberries), encourage diversity of cultural practices, and promote cultural identity (Lake, 2013).

Our Approach and Principles Guiding Our Work

Our research is based on the methods and principles of CBPR, which grounds the design, implementation, analysis, and dissemination of research in community-led processes aimed at social transformation, community health, and ecosystem rehabilitation (Cornwall & Jewkes, 1995; Fals Borda, 1982, 1984, 2001). The emphasis on direct community participation and explicit attention to power dynamics in knowledge production is particularly important for research conducted with Indigenous communities, as the existence and value of Indigenous knowledge systems were systematically denied or marginalized in the process of colonization (Nadasdy, 2004; Reo & Whyte, 2011; Sundberg, 2014; Whitt 2009; Wråkberg & Granqvist, 2014). Recent histories of biocolonialism, cultural appropriation, resource extraction, and their associated impacts on Indigenous peoples demonstrate the risks at stake in supposedly "collaborative" research endeavors (Hayden, 2003; Karuk Tribe et al., 2017; Whitt, 2009). As Linda Tuhiwai Smith remarks, "research is one of the ways in which the code of imperialism and colonialism is both regulated and realized" (1999, p. 7). In alignment with Indigenous scholars and activists, we support the explicit decolonization of knowledge production, revitalization of Indigenous knowledge ways, and engagement of Indigenous people in research, management and policy processes (Bussey, Davenport, Emery, & Carroll, 2015; Carroll, 2015; Carroll, Garroutte, Noonan, & Buchwald, 2018; Kimmerer 2002, 2011, 2013; TallBear, 2014; Whyte 2017; Whyte, Brewer, & Johnson, 2016).

Our collaborative research endeavor entailed working through the difficult process of decolonizing knowledge relations between UC Berkeley and the tribes of the Klamath. Historically, UC Berkeley researchers collected stories, artifacts, ceremonial regalia, plant specimens, and even human remains from the Klamath. While some artifacts and remains have been returned to the Tribes, the legacy of the historical museumization of Native American culture by researchers from UC Berkeley specifically has created a significant trust barrier we have had to overcome (Rouvier, 2010).

Through the Karuk-UC Berkeley Collaborative (KBC), we attempted to develop a decolonial epistemology to bridge our diverse ways of producing knowledge about the world and to support Karuk eco-cultural revitalization initiatives. We have worked to create the conditions for transformative, community-driven research and extension and a clear process for tribal oversight to protect tribal cultural, intellectual, and material property. The main focus of our work has been following or developing tribal research protocols that simultaneously guard against misappropriation of tribal cultural and intellectual property and ensure that outside research is directed at ecological restoration and community empowerment (Karuk-UC Berkeley Collaborative, 2013). A document for guiding research and practice, *Practicing Píkyav: A Guiding Policy for Collaborative Projects and Research Initiatives with the Karuk Tribe* (KBC, 2013), was co-created by the Karuk Tribe and UC Berkeley researchers to structure collaborative research done on Karuk Aboriginal Territory and with Karuk people. The Karuk word *píkyav* means "to fix it," and in the context of true collaboration, we felt it imperative

to acknowledge "individuals and institutions at UC Berkeley and other institutions have not always acted in the best interest of California Indian Tribes" and to begin "mending problematic relationships among universities, researchers, and Indigenous peoples" (KBC, 2013, p. 10). Our team also followed the Yurok and Klamath Tribe protocols of oversight, including seeking approval from elder and tribal councils.

A second document, *Karuk Tribe Protocol with Agreement for Intellectual Property Rights of the Karuk Tribe: Research, Publication and Recordings* (Karuk Tribal Council, 2015), addresses issues of ownership regarding data and final research products. For the Karuk Tribe, these documents became a test of authentic partnership: were nontribal researchers and project participants truly dedicated to the principles of collaborative research and the protection of tribal intellectual property? With community-driven specification of not only the research priorities, study design, and data interpretation, but also the terms of ownership and authorship of research materials and products, tribal leaders, elders, and community members began to engage more freely with project stakeholders.

Integrating Indigenous and Western scientific knowledges into our food security research further acknowledges and validates multiple ways of knowing, improves research questions and outcomes, and ensures relevancy for Native American communities. Indigenous, traditional, and local knowledge generally refers to "a cumulative body of knowledge, know-how, practices, and representations maintained and developed by peoples with extended histories of interaction with the natural environment" (International Council for Science, 2002, p. 9). Indigenous knowledge (IK) systems secure the continuity of cultural stewardship practices and are maintained by Indigenous languages, seasonal teachings and training, cultural values, beliefs, ceremonies, stewardship practices, community laws, and governance systems (Lake, Parrotta, Giardina, & Davidson-Hunt, 2018). IK is a dynamic, adaptable system that is based on problem-solving skills linked to place-based experience on the land (Martens et al., 2016). The integrity of the knowledge depends on maintaining intergenerational knowledge transference and "integrity of the land itself" (Battiste, 2005, p. 8). IK or traditional ecological knowledge (TEK) thus has a strong potential for informing the science of ecological restoration (Kimmerer, 2000; Martinez, 1994).

Food Security, Native Foods Security, and Indigenous Food Sovereignty

Our research intentionally engages with the concept of food security,[5] as it is the dominant discourse in the U.S. used to define, measure, and develop solutions to hunger and malnutrition. We also engage the concept of food sovereignty,[6] which centers around the politics, inequalities, and exclusions inherent to global commodity food systems, as well as the right of people to define their own food and agriculture systems (Holt-Giménez, 2010; La Via Campesina, 2003). Our work aligns with emergent concepts of Indigenous food sovereignty, which emphasize decolonization, self-determination, and the inclusion of hunting, fishing, and gathering, as well as cultural and spiritual relations of exchange. These are ideals excluded from the dominant food security discourse and the more agrarian rights–based food sovereignty framework (Desmarais & Wittman, 2014; Grey & Patel, 2014; Kamal, Linklater, Thompson, Dipple, & Ithinto Mechisowin Committee, 2015). As Hoover explains, "the concept of Indigenous food sovereignty is not just focused on *rights* to land and food and the ability to control a production system, but also *responsibilities* to them, which encompasses culturally, ecologically, and spiritually appropriate *relationships* with elements of those systems" (2017, p. 39; emphasis in original).

[5] The USDA defines food security as "consistent, dependable access to enough food for active, healthy living" (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017, p. 1) and includes as a minimum (a) "the ready availability of nutritionally adequate and safe foods," and (b) "the assured ability to acquire acceptable foods in socially acceptable ways (without resorting to emergency food supplies, scavenging, stealing, and other coping strategies)" (USDA, 2019, "What Is Food Security?").

[6] In 2007 a collective group of farmers and Indigenous peoples assembled in Mali established the Declaration of Nyéléni, defining food sovereignty as "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Forum for Food Sovereignty, 2007, para. 3).

In our approach, we treat food security and food sovereignty as distinct but interrelated concepts (Clapp, 2014; Jarosz, 2014). We believe genuine food security in Native American communities cannot be achieved without considering tribal sovereignty over territory and cultural resources, self-governance, and explicit confrontation of the colonial legacies impacting Indigenous food systems, including government food aid. To bridge the two concepts, we developed a community-based definition and method for measuring *native foods security:* having physical, economic, social, and legal access to all desired native foods with the appropriate quality and quantity throughout the year, and continuity of the cultural institutions that sustain them, including traditional ecological knowledge, social support networks, and cultural resource stewardship (Sowerwine et al., 2019). This added dimension of food security—native foods security—provides a more culturally relevant way to understand and measure food security in Native American communities by operationalizing Indigenous food sovereignty principles into tangible, measurable goals to improve the native food system and access to native foods for tribal members.

The next section provides more detail and specific examples of how CBPR and Indigenous knowledge, in particular, informed the development, implementation, and outcomes of key research, education and extension objectives in critical ways to support Indigenous food sovereignty.

Integrating CBPR into Research, Education, and Extension Objectives

Integrating Native Foods and Food Sovereignty into Food Security Research

To capture a comprehensive snapshot of the food system from a tribal perspective in the Klamath River Basin, we adapted the USDA Community Food Security Assessment Toolkit (Cohen, Andrews, & Kantor, 2002) with tribal collaborators in order to better suit the mixed-food economies and cultural food practices of Native American communities (Sowerwine et al., 2019). Rather than focus on the standard county-based unit of analysis, which often inadequately captures voices of Native people due to their relatively small population size, we focused on the bio-cultural region of the Klamath River Basin spanning four tribes, five counties, and two states, with priority on foregrounding Native voices and perspectives. Nearly 1,000 tribal residents of the Klamath Basin participated in our assessment, offering a unique tribal perspective on community needs and desires for systemic food system change. We employed mixed methods, collecting qualitative and quantitative data from May 2015 to October 2016, through (1) a household survey distributed to all listed Karuk, Yurok, Hoopa, and Klamath Tribal member and descendent households; (2) key informant interviews with tribal cultural practitioners and food system stakeholders[7]; and (3) focus groups with adults, low-income adults, and youth from the Karuk Tribe, Yurok Tribe, and Klamath Tribes. In total, we completed 711 household surveys, 115 key informant interviews, 47 tribal cultural practitioner interviews, and 20 focus groups (with 128 tribal participants). Quantitative data were analyzed using STATA, and qualitative data were coded using content analysis in NVivo (version 11.4.3).

Since the development of a standardized national measurement of food security in 1995, a version of the Household Food Security Survey Module (HFSSM) has been used by federal agencies, researchers, and community groups to evaluate and monitor food security and nutrition in the U.S. (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). A portion of our assessment considered household food security and examined the appropriateness of the HFSSM measures for Native American communities.

In the design of our assessment, we worked with tribal collaborators to select and adapt a subset of the HFSSM questions related to accessing healthy foods, running out of food, running out of

[7] Food system stakeholders included the U.S. Fish and Wildlife Service, U.S. Forest Service, a local NGO, school lunch programs, Tribal Temporary Assistance for Needy Families (TANF) programs, Tribal Heritage Preservation Officers, local food vendors and food distributors, food assistance programs, local community and school gardens, and local health clinics.

money for groceries, buying less expensive meals, reducing the size of or skipping meals, and accepting food assistance (Sowerwine et al., 2019). We also added a number of culturally relevant questions suggested by our tribal collaborators related to the acquisition, exchange, and consumption of native foods and native foods–related knowledge, which contributed to the development of a novel indicator of food security in Native American communities: native foods security, that is, access to desired native foods throughout the year (Sowerwine et al., 2019).

In addition to finding extremely high rates of poverty and food insecurity, as noted earlier, we also found severe rates of *native foods* insecurity, with nearly 70% of all households never or rarely having access to all desired native foods throughout the year. As a result, 64% of Native American households in the region have been forced to rely on food assistance, compared with 12% nationally, and 20% reported dependence on food assistance because Native foods were not available (Sowerwine et al., 2019). Food assistance, however, is only a partial solution, as 84% of food assistance users still worry about running out of food (Sowerwine et al., 2019). Our findings suggest that supporting improved access to native foods will likely improve household food security, since households with high food security tend to have the best access to native foods.[8]

Study participants consistently voiced the desire for food sovereignty, wanting clear and consistent hunting, fishing, and gathering rights, improved quality of native foods through restoration efforts and prescribed fire, strong community and family relationships to facilitate the transfer of food and knowledge, and more affordable healthy foods in local grocery stores—but *not* more food assistance. In multivariate models predictive of food security and native foods security, many cultural variables, such as those associated with traditional knowledge and native food acquisition and exchange strategies, were significant predictors not only of native foods security but also of food security (Sowerwine et. al, 2019). Ultimately, our assessment found the HFSSM useful for measuring some components of household food security but lacking consideration for native foods and cultural food practices important to food security in Native American households. Thus, we recommend incorporating measures of native foods security and related socio-cultural variables into the HFSSM when evaluating food security among Native American households to ensure a more holistic understanding of and culturally-relevant response to food insecurity by and for Native American communities.

Our findings also call for a radical transformation of government food assistance policy and programs in Native American communities, directing investment toward eco-cultural restoration of Native food systems and support for tribal self-determination rather than continuing to reproduce neo-colonial models that reinforce food-aid dependency and undermine Indigenous food sovereignty (Mucioki et al., 2018).

Native Foods and Fire Ecology Research

We developed an integrated research framework to investigate which metrics are important for assessing changes in the condition of forests dominated by tanoak (*Notholithocarpus densiflorus*) and evergreen huckleberry (*Vaccinium ovatum*) across the Western Klamath mountain landscape. The field experimental research approaches integrated Indigenous/tribal and Western scientific knowledge of desired ecological and cultural conditions for tanoak and huckleberry forests, factors supporting acorn and huckleberry production, and tribal management strategies to enhance tree- and shrub-specific characteristics (Rossier & Lake, 2014). IK guided the development of tribally generated research questions based on tribal priorities and gaps in Western science to investigate how the current condition of tanoak and huckleberry–dominated forest, thinning of understory vegetation, and wildland fire affects tribal opportunities to access, harvest, and utilize these traditional foods (Figure 1). Forest and fire ecology were evaluated using ecological characteristics and sociocultural elements (e.g., aerial LiDAR to characterize forests, forestry plots, and acorn and huckleberry gathering

[8] We found that 67.86% of households with high food security stated that they usually or always have access to desired native foods.

site condition surveys) across scales ranging from regional to forest management unit, habitat to patch/stand, individual tree and acorn, and shrub and berry quality. This approach aligned habitat and resource quality evaluation methods of foresters and ecologists with those of tribal practitioners, providing unique insights about treatments (such as pruning, thinning and prescribed burning) and fire effects on acorn and huckleberry production for tribal food security (Rossier & Lake, 2014).

Project site selection and sampling techniques integrated Indigenous knowledge from cultural practices and Western scientific discipline-specific sampling methods. At the landscape scale, project sites were co-identified by researchers and tribes; at the habitat level, we focused on the tanoak-huckleberry–dominated sites; at the patch/stand level, project plots were established in areas that are or would be suitable for tribal gathering. Then, within each research plot, specific tanoak trees and huckleberry bushes were inventoried, and resource quality characteristics were sampled using metrics that ecologists and practitioners use (for a similar example, for basketry, see Hummel, Lake, & Watts, 2015). This integrated data collection approach allowed for a standardized data set about forest site- and resource-specific condition evaluation (e.g., tree species diversity and size and diameter, tree and shrub density, height, and cover percentage, canopy cover and light of the overstory) cou-

Figure 1. Using Culturally Appropriate Fire at the Base of Tanoak Acorn Trees to Support the Health of and Access to This Important Cultural Food for Middle and Lower Basin Tribes

At Klamath River TREX (Training Exchange) in October 2015 near Orleans, California.

Photo Credit: Lake U.S. Forest Service and Karuk Tribe.

pled with additional metrics that are important to tribal practitioners (e.g., berry and acorn abundance and quality). In addition, we surveyed the understory ladder and surface fuel load, which affect tribal practitioner access and foraging and gathering. At the same time, Karuk Tribe technicians conducted "food grove" assessments, which emphasized tribal criteria for the condition, quantity, and quality of tribally valued food and other cultural resources present at those sites.

In regions where federal or state governmental public lands encompass a Tribe or Indigenous group's ancestral territory, the surveys, protocols, and resulting data from collaborative assessments of tribal landscapes can strengthen Indigenous food sovereignty where forest landscape restoration strategies regarding forest and wildland fire management align with work to support food and water security (Lake, Parrotta, Giardina, Davidson-Hunt, & Uprety, 2018; Long & Lake, 2018; Sarna-Wojcicki, Sowerwine, Hillman, Hillman, & Tripp, 2019).

Karuk Tribe K-12 Native American Food Security Curriculum

The underlying principles of CBPR also guided the design, publication, and implementation of lesson plans developed for our Native Foods Curriculum objective. Community stakeholder discussions and the results of a 2014 Karuk Tribal Survey of needs for culturally responsive curricula mirrored a 2014 White House report that declared, "Native youth and Native education are in a state of emergency" (Executive Office, 2014, p. 19). Leading causes of low academic performance include a lack of culturally relevant curriculum and of culturally competent staff who understand how to reach Native youth.

We aimed to create a K-12 curriculum on the Native foods system. Respecting the wishes of the tribal community, we developed lesson plans that were relevant to students growing up within the aboriginal territories of our tribal partners. We consulted cultural practitioners to ensure the authenticity of the traditional knowledge imparted. Further, these lesson plans were not only aligned with the California Common Core Standards for English Language Arts and Literacy (California Department of Education, 2013), but they were written by and for tribal people, representing a culturally responsive education that "recognizes, respects, and uses students' identities and backgrounds as meaningful sources for creating optimal learning environments" (Gay, 2000, p. 3). Lessons also encourage the participation of parents and cultural practitioners, and facilitate student ability to learn place-based history, science, and culture all in one lesson, an approach that is consistent with the demonstrated preference of Native American students for experiential indoor-outdoor learning environments (Zwick & Miller, 1996) and curriculum that is culture- and place-based (Kawagley & Barnhardt, 1999) (Figure 2). Leaf Hillman, the Karuk Tribe director of natural resources and environmental policy, articulates the value of integrating IK into K-12 lesson plans:

> The Indian Boarding School era was one of many factors leading to the inter-generational trauma Native peoples experience today. By incorporating Native American traditional ecological knowledge into the lessons taught in local schools, we hope to mitigate some of the wrongs done to our people in the past. . . . This effort represents a valuable contribution to tribal sovereignty.

Integrating cultural values into educational curricula and pedagogy is by no means a new idea. Policy recommendations hereto have been salient in a host of official reports on Indigenous education, including the 1928 Meriam Report, which advised employing more Indigenous teachers, implementing early childhood programs, and integrating tribal languages and culture into schools as potential solutions to the ongoing underperformance of Indigenous students (Castagno & Brayboy, 2008). And while these recommendations have remained largely unheeded by school administrators, researchers continue to show that educating students in culturally responsive ways yields improved academic outcomes. Conversely, educating Indigenous students through assimilative processes has failed to improve academic success (Castagno & Jones Brayboy, 2008; Demmert, 2001).

With the active support of the community and this research in mind, the Karuk Tribe finalized 89 lesson plans that center content relevant to tribal identity and the traditional food system. Modeled after lessons developed by the Klamath-Trinity Joint Unified School District under an Indian Land Tenure Foundation grant, the *Nanu'ávaha* ("Our Food") K-12 curriculum has been met with widespread stakeholder endorsement and has been adopted by the school boards of three public school districts. Reported outcomes have included increased student engagement, willingness to complete lesson assignments, and a changing dynamic with "at risk" student populations (Talley, 2016). Local K-3 teacher Denise described the impact the curriculum has had on Native children's self-esteem while building their interest and connection to school:

> Kids who don't necessarily identify with other parts of school are like "I know this. I know this, I can share this, this is important". . . school is different than other parts of their lives, so they can see a connection between what they know and what's valuable learning—it just makes it more real. (Talley, 2016, p. 64)

The increased number of elementary school students conducting research on Karuk tribal history and sovereignty may also be attributable to this tribal curriculum. The results of the 2016 Karuk Tribal Needs Assessment for K-12 Education demonstrated the overwhelming support for

Figure 2. Youth in Happy Camp, California, Learn How to Prepare and Cook Pacific Lamprey (*Lampetra tridentate*)

these culturally relevant environmental education lessons. Since then, the Karuk Tribe has been awarded a four-year grant by the U. S. Department of Education to continue expanding upon this successful model project.

Establishment of Karuk and Yurok Tribal Herbaria

A herbarium is a collection of dried plant samples and associated data used for long-term research and educational purposes. These materials, called herbarium specimens, may include pressed and mounted plants, seeds, fungi, dry fruits, wood sections, pollen, frozen DNA extractions, and fruit-preserved flowers or fruits. Like other museum collections, plants gathered in tribal territories often find their way into university collections, yet tribes have little familiarity with or access to these plant specimens, as herbaria are usually affiliated with universities, museums, and botanical gardens. There are approximately 3,000 herbaria in over 165 countries, with an estimated 350 million specimens (University of Florida Herbarium, 2004). To date, the Karuk and Yurok Herbaria are two of only three known tribal herbaria (the Navajo Nation Herbarium (NAVA) was the first, established in 1997 [Navajo Natural Heritage Program, 2019]).

Throughout the course of our project, the Karuk and Yurok Tribes collected, pressed and mounted, and preserved hundreds of plant specimens of cultural and regional significance, including food, medicine, baskets, bows, nets, regalia, ceremonial, and other traditional uses. In partnership with the university and the Jepson Herbaria at UC Berkeley, natural resource technicians from each tribe were trained in voucher specimen collection, mounting, and long-term preservation by visiting the herbaria at Berkeley and receiving training locally from Berkeley professors and postdocs. Tribal staff guided university researchers in plant collecting, drawing on Indigenous knowledge of the location, phenology, and quality of culturally important plants and their uses. Tribal codes that are founded on Karuk TEK govern where and how plants are collected for the herbaria, ensuring that plant populations are maintained sustainably. Photographs and related data accompanied each pressed plant, with the goal of using the collection to increase the ability of tribal people to recognize, locate, and consume food plants and use fiber plants, while building their knowledge about the importance of these plants for nutrition, health, and cultural traditions.

At the end of the five-year project, tribal technicians continue to train tribal youth and adults in voucher specimen collection and mounting, lessons which have since been integrated into tribal curriculum and other workshops (Figure 3). While the science of voucher specimen collection and preservation is grounded in Western science disciplines of plant and archival science, the tribal herbaria support and sustain cultural plant knowledge and its transmission. Plant habitat, cultural use, and related ethnobotanical knowledge are often embedded in Karuk plant names, and as such guide how plants are classified and cataloged in the Karuk herbaria. Because herbaria collections can last for hundreds of years,[9] tribes can utilize these culturally important plant collections for myriad research purposes, such as monitoring the distribution and range of culturally important plants under changing climate conditions and supporting conservation efforts.

Establishing the Píkyav Field Institute: A Tribally Led Academic and Vocational Education, Training, and Research Institute

Faced with continued and, finally, unresolvable hurdles in completing one of our educational objectives, "to create a 24-unit community college Native American Food Security Certificate in agricultural and traditional foods" (UCB, 2018), due to staff position turnover and community college defunding, project leaders decided in the project's third year to redirect efforts in favor of consolidating, enhancing, and sustaining the long-standing environmental education, training, and research opportunities offered by the Karuk Tribe Department of Natural Resources (KDNR). Our tribal partners reasoned that a culturally responsive education in food security needs to begin at home and in the community, continue in classrooms and field curricula offered at local schools, and carry

[9] The oldest known herbarium is believed to be in Bologna, Italy, dating from around 1532 (University of Florida Herbarium, 2004).

into the skills and practices of the workforce. In alignment with the principles and philosophy guiding KDNR's integrated approach to contemporary adaptive land and resource management, as described in their Eco-Cultural Resources Management Plan (Karuk Tribe, 2010), higher education and research opportunities should be grounded not only in the teachings of Western science, but also in Indigenous knowledge.

With these goals in mind, and supported by project partners, informed by the early successes of the Food Security project, and guided by the results of a tribal needs assessment for K-12 education, our Karuk partners detailed their vision for culturally responsive environmental education in the KDNR Strategic Plan. Named for the Karuk word for "to fix it," the Píkyav Field Institute was conceptualized to include five divisions related to academic and vocational education, training, and research: K-12 Environmental Education, Environmental Workforce Development and Internships, Environmental Higher Education and Research, Food Security, and the Sípnuuk Digital Library. Leveraging infrastructure, tribal capacity, and experience gained through the Food Security grant, the Karuk Tribe was able to win a number of subsequent grant awards to build each of the five divisions. In the Food Security grant's final year, the Karuk Tribe was awarded a four-year grant by the U.S. Department of Education, officially launching the Píkyav Field Institute in support of college and career readiness of tribal youth. In reconnecting tribal youth with their cultural heritage, the project aims to improve tribal student self-esteem and understanding of important connections between K-12 lesson content, tribal identity and responsibilities, and academic achievement related to their personal career and college goals (Fox, 2006).

Integrating Cultural Values Into Extension

Development of extension programming in tribal

Figure 3. Youth in Orleans, California, Learning about Pressing and Mounting Herbarium Voucher Specimens for the Karuk Herbarium

Photo credit: The Karuk Tribe.

communities takes time, humility, and an honest acknowledgment of the colonial legacy of extension (Smith, 2013; Stein, 2017; Whitt, 2009). The very term "extension" emanates from a knowledge deficit model inherent in Western scientific modes of knowledge production and dissemination (Calo, 2018). It implies that extension agents are "extending" scientific knowledge to communities that lack this knowledge. Integrating IK into food system extension programming prioritizes Native American teachers and teachings, oral history transmission through storytelling, a focus on native foods, and intergenerational knowledge transference, helping to heal intergenerational trauma, promote cultural identity, and deepen connections between people, place, and spirit. Engaging tribal cultural practitioners as co-leaders in the design of extension programming, such as food-related workshops and 4-H, demonstrates respect for their knowledge, contributes place-based traditional ecological knowledge, ensures that the content of the workshops is relevant to the tribal community, and encourages participation of intended audiences.

Over the course of the Tribal Food Security Project, the Karuk, Yurok and Klamath Tribes hosted 238 regular workshops and 58 seasonal food camps focused on understanding, finding, gathering and processing edible native foods and fibers as well as other subsistence skills, reaching thousands of tribal members and descendants with knowledge that had been lost to many families, and this programming continues. Taught by experienced cultural practitioners and tribal elders, Native food workshop offerings have included acorn harvest and preparation, eel preparation, salmon smoker construction, pit oven cooking, deer and salmon canning, hide tanning, camas digging and cooking, wocus harvest and preparation, tule mat weaving, traditional basketry, willow gathering, spring medicine, history of management practices, fish and plant identification, and many more activities (Figure 4). At the end of each event, participants evaluated how much they had learned and their intent to apply what they learned. While responses varied somewhat, the majority of participants found them beneficial. For example, 80% to 100% of participants across all camps reported learning something new, and 63% to 100% said that they wanted to learn more or to implement what they learned. One participant shared the value

Figure 4. Women Weaving Tule Mats at a Workshop in the Upper Klamath River Basin

of the workshops in reviving traditional knowledge:

> I grew up with acorns in my household and it had not been as present in my adult life. The food security activities have REALLY brought it back to a central place in my life. From the workshops I've attended to the kids coming home talking about acorns. It's balancing *to have the native knowledge infused into regular daily things like doing laundry*.

Workshops such as these have helped build subsistence skills and an infrastructure for increased community confidence, access to healthy foods, and survival strategies. As one participant articulated,

> I have learned something new in every class. I knew some basics of canning, pruning, butchering, grafting, seed saving, bread making, fermented foods, sourdough bread, and drip irrigation but after the class, I felt more confident in my own abilities to move forward with knowledge that was shared.

Efforts to start a 4-H program, on the other hand, were met with limited success, as 4-H programming was perceived to be focused heavily on livestock production and farming, both of which are associated with the colonization of Native lands and people, and Native Californians historically were never farmers or ranchers. While 4-H programs can be adapted to local conditions, it takes time to engage tribal leaders in exploring options and co-designing the program. Ultimately, the Karuk Tribe opted to develop its own after-school leadership and youth development program rooted in the restoration of cultural knowledge and values around Native foods and stewardship principles. This innovative program, *Ishkêesh'tunviiv* (River Kids), integrating Native values and cultural foods into afterschool programming has become an institution in the Mid-Klamath, engaging 141 both tribal and nontribal youth in activities that feature Karuk native foods and associated cultural heritage. The goal is to provide background information such as history of management practices, general biological and botanical information necessary for fish and plant identification, hands-on experience with Native food sources, and to encourage the community to feel comfortable with the resources available to them. Activities include harvesting, food preparation, cultural plant pressing, art, and storytelling. This program is supported by a diverse group of educators using a combination of Western science and TEK. As part of the evaluation, parents and teachers were asked to share their impressions; 95% of the respondents expressed support for the approach, incorporating heritage, traditional foods and medicines. Many described the children's enthusiasm for learning about and harvesting Native foods that were introduced in sessions:

> On the way home from school, [a child] made me stop at all the madrones and service berries to gather berries. He didn't stop talking about what he'd learned until we got home. (Karuk Tribe parent assessment)

> I loved watching the kids talk about some of the plants they learned about, and what they did or how they cracked acorns. They were really funny and cute—enthusiastic. I think they were proud of being Karuk. (Evaluation participant)

Partnering with the Oregon State University Master Gardener program helped to address the lack of human resources identified as one of the challenges to implementing community and home gardens in the Klamath Tribe ancestral territory, the Upper Klamath. The Food Security Project paid the tuition for eight Klamath Tribal members to complete the 60-hour Master Gardener training program. Graduates perform volunteer hours to keep Food Security projects moving forward in the Klamath Falls and Chiloquin, Oregon, area, and are continuing to offer local residents the popular Seed to Supper curriculum, a six-week class that reached 66 students over the life of the grant.

Summary of Project Outcomes and Reflections on Lessons Learned

Over five years, more than 1,300 educational events increased stakeholder knowledge and capac-

ity to engage in transformative food system change. Project activities reached 17,498 participants (many of whom were repeat participants), the majority of whom were Native, and 55% of whom were youth. All three participating tribes leveraged project successes to secure an additional US$6,093,216 (to date) for expanded and continuing food security and food systems programming.[10]

In an evaluation of 111 project participants through online or phone surveys near the end of the grant, 76% reported that they had learned something new, and 68% had applied new skills at home, while 65% felt the community was more food secure and 81% felt that the project had changed the community in other positive ways.[11] We offer some reflections and lessons learned highlighting both challenges and successes that we hope can support other tribes, universities, federal and state agencies, and nonprofits seeking to develop partnerships to strengthen Indigenous food sovereignty.

Strengthening Local Capacity and Leveraging New Relationships to Improve the Food System

Opportunities to strengthen local capacity included education, professional development, and infrastructure development, as well as leveraging new regional partnerships to sustain project outcomes beyond the grant. Virtual shared learning networks proved invaluable, such as the Mid-Klamath Foodshed Facebook page, which became a primary hub of information exchange where over 700 people continue to trade garden starts, ideas and information, and news about upcoming events. Regionally appropriate technical bulletins on gardening and farming developed under the grant remain available free of charge on the Mid-Klamath Watershed Council website (MKWC, 2019). Both the MKWC and the Karuk Tribe leveraged this project to secure two new USDA Farm to School projects. They also joined forces to identify and rehabilitate 17 abandoned orchards by training tribal technicians in orchard assessment, pruning, grafting, and restoration. Through an innovative partnership between the Klamath Tribes and the Oregon Institute of Technology, a team of students constructed several greenhouses for the tribes free of charge as part of a greenhouse design competition. Furthermore, co-producing workshops with other organizations has strengthened regional relationships, laying the groundwork for ongoing knowledge exchange.

Food Sovereignty as a Precondition for Food Security in Native American Communities

As discussed previously, there are unique food security considerations for Native Americans related to harvesting, sharing, and consuming traditional and native foods that are often overlooked in standard research studies on food security. Our study found that access to native foods and intergenerational knowledge transference were strong predictors of food security, suggesting that food security assessments and interventions in Native American communities should consider principles of food sovereignty that include self-determination and the ability not only to access healthy, affordable foods and all desired native foods, but also to *steward* the landscapes and habitats with cultural management practices, such as prescribed burning, to enhance the productivity, availability and quality of Native foods and fibers. Stewardship of cultural landscapes for Native foods and fibers requires and enables intergenerational transmission of Indigenous knowledge, improving not only nutritional health, but also strengthening cultural identity and associated physical and mental health and cultural well-being. In other words, genuine food security in Native American communities, we argue, cannot be achieved without food sovereignty. This understanding helped guide our research on food secu-

[10] Together with the Karuk Tribe, the University of California project team recently secured a US$1.2 million, three-year grant from the USDA AFRI Resilient Agroecosystems in a Changing Climate Challenge Area program to conduct research and augment tribal capacity to assess, monitor, and revitalize traditional food and fiber plants in Karuk Aboriginal Territory under changing climate conditions.

[11] For more information on the activities, outputs, and impacts of the larger project, including project newsletters, workshops, blogs, tribal food system assessments, and other publications, visit the Karuk-UC Berkeley website at https://nature.berkeley.edu/karuk-collaborative/

rity to be more inclusive of tribal concerns and ideas for increasing tribal stewardship of forests and fisheries, and made the case for redefining how food security is defined and measured in Native American communities (Sowerwine et al., 2019).

Tribal Leadership, Staffing, and Funding

Academic research institutions seeking to partner with tribes on grant-funded projects should offer tribal partners PI status and dedicated funding for tribal staff and travel in order to help strengthen tribal capacity, promote professional development, and enable full participation by tribal partners. Equitable allocation of funding and directorship signifies respect and commitment to equity and inclusion. Our project was collaboratively designed by Klamath Basin tribal and community members, guided by co-project directors that included four tribal representatives (50% of the leadership team), and staffed locally by 15 primarily tribal hires, both full- and part- time. Tribal co-PIs contributed to the proposal development, co-development of research questions, and identification and equitable allocation of funding needs and extension programming that they sought to prioritize.[12] Each tribe received a subaward equivalent to and in one case larger than the university prime sponsor. However, because the university had no experience subcontracting with tribes, there were significant delays in getting subaward approval, and subsequent delays in administering the funds once the grant was awarded, due to bureaucratic university hurdles. This impeded our attempts to build a better and more equitable relationship between the university and the tribe.

Building and Maintaining Relationships of Trust

Building successful partnerships with tribes requires learning about tribal relationships, governance structures, and cultural norms. For example, when identifying with whom to partner, there may be traditional governance councils beyond the official tribal council such as an elders' council, a tribal heritage preservation officer, a renowned cultural practitioner, or a cultural resource advisory board that must be consulted. In addition, it is important to understand the complexity of social, family, and community relationships when considering outreach, programming, participant recruitment, and implementation strategies. In light of historical circumstances, it can take time to establish relationships of trust, so starting early is important. Even after trust and partnerships are established, it is important to maintain strong, open communication lines, as misunderstandings inevitably arise over deadlines, expectations, and clarity of roles and responsibilities.

Flexibility and Adaptability

Priorities and capacity may shift over time with staff turnover and new hires, as new partnership opportunities arise, or as the feasibility of certain activities come into question due to technological challenges, delayed funding, insufficient resources, and greater understanding of need and capacity. USDA and partner flexibility to adapt timelines and/or programming based on lessons learned in real time resulted in stronger outcomes. Regular monthly check-ins allowed for ongoing course correction. For example, as project team members began to carry out the objective of promoting intertribal trade of cultural foods and fibers, it was realized that because of the limited availability of those resources, there was insufficient volume to engage in trade. The objective was then adapted to support intertribal youth and family exchange focused on sharing knowledge and skills related to the procurement and preparation of cultural foods and cultural resources.

Our CBPR approach guided an iterative development of assessment tools that was time-consuming but resulted in a survey that both reflected the questions most important to our tribal partners and was carefully worded so as to protect confidential tribal information, such as family gathering sites. While the food system assessment

[12] It is important to keep in mind that tribes may have funding needs for specific responsibilities that academic researchers may not be familiar with or may have overlooked that need a dedicated budget, such as tribal oversight, high cost of transportation as distances from a tribal center can be extensive, cost of staff time to recruit participants, attend meetings, and conduct project evaluations, and offering meals and/or other forms of reciprocity to study participants.

was originally intended to be completed by the end of the grant's second year, to help guide subsequent programming, the realities of delayed funding and hiring, collaborative tool development with multiple community partners, three separate tribal approval processes, and scheduling hundreds of focus groups and interviews meant that assessment design alone took nearly a year, and end-to-end implementation took well over a year. While the impact of this delay was mitigated in our case by the collaborative project management structure of the grant, which allowed for constant tribal input into project activities, groups aiming to conduct food system/food sovereignty assessments as guidance for planning should ensure adequate time for the steps required.

Acknowledging Diverse Institutional Cultures and Norms

Tribes may have different research approval processes, timelines, and institutional resources to support grant applications, which should be taken into account. For example, tribes may have research protocols, such as those described in this article, and/or require input from multiple tribal entities such as elders, cultural resources, and/or tribal councils prior to submission. Universities seek protection of *university* intellectual property, and Institutional Review Boards (IRBs) are designed to protect *individual* human subjects; however, they are not designed to protect the collective and individual intellectual property of Indigenous communities. This concern led our team to develop several mechanisms for tribal oversight of our project in addition to the *Practicing Píkyav* protocol discussed above. First, we co-developed the grant proposal with tribal partners and sought approval from elder, cultural, and tribal councils before submission. Second, a tribal staff member was responsible for overseeing the development and implementation of each objective. This helped keep researchers accountable to tribal priorities and governance requirements and ensured protection of intellectual property.

Contrasting Incentives and Rewards

Tensions can sometimes arise between academic and agency merit and evaluation processes, and tribal goals. Granting agencies, for example, expect quantified reporting of outputs and outcomes, which requires formalized evaluation techniques that are not always culturally appropriate. Academic institutions similarly evaluate merit based on standards that are often out of sync with tribal values and timelines. Merit and promotion at academic institutions value single and first-authored publications in peer-reviewed academic journals, while many Indigenous communities perceive knowledge as collectively held. What constitutes authorship can sometimes raise questions that are difficult to answer, and tribal review processes, critical to ensuring equity in research, may require a longer time frame. It is therefore necessary that academic institutions understand and acknowledge the principles of CBPR and not penalize researchers who are committed to authentic community partnerships and tribal oversight in publication. It is also important to acknowledge that publishing may be a less significant priority for tribal partners: it may not be part of their reward structure, it can require a huge amount of time, and it may not align with their cultural norms of sharing knowledge. Nevertheless, it is essential as academics and educators committed to CBPR to consider co-authorship and jointly holding copyright with community partners and/or tribal organizations, secure permission for publication, and continue to promote scholarship that not only advances our careers but also advances the well-being of tribal communities. Translating research results into articles for tribal newsletters, blogs on tribal community Facebook pages, community presentations or symposia, policy briefs, white papers, and reports with accessible data and findings can provide tribes with critical data and resources they can leverage when applying for new grants, engaging in government-to-government consultations, communicating with policy-makers, developing tribal programming to address identified challenges, and teaching the next generation of tribal youth.

Conclusion

Multi-agency partnerships with tribes to achieve food sovereignty require attention to the historical impact and ongoing legacy of colonization and institutionalized racism, which contribute to the

vast educational, economic, health, and nutritional disparities observed in Native American communities across the country. Collaborative partnerships require deep listening, respect, inquiry, and commitment to dismantling research, educational, and extension hierarchies. Employing a CBPR framework placed tribal goals at the center of this project, guided by Practicing Píkyav**,** a new policy for engagement developed by UCB researchers and the Karuk Tribe to establish equitable ground rules for project work.

Integrating cultural values and Indigenous knowledge into food security research, education, and extension helped illuminate crucial conditions under which true food security would not be attainable without consideration of Native foods and food sovereignty. Indigenous food security and sovereignty are facilitated by collaborating with tribes as co-equal research partners to guide, inform, direct, and participate with oversight in the full research cycle process: contributing to research questions, site selection, methods, analysis, interpretation of results, and communicating findings and implications to inform policy and management strategies, prescriptions, and treatments.

Challenges in collaborative partnerships inevitably arise that emanate from differences in institutional cultures, expectations, delayed funding, and shifts in priorities, and that can threaten to undermine the collaboration. It is therefore imperative to maintain transparency and honesty, open lines of communication, and recognize that relationships of trust require time, ongoing cultivation, and authentic respect for tribal knowledge, tribal sovereignty, and tribal self-determination.

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