

## FEATURE

# Addressing Food-Energy-Water Insecurities of the Navajo Nation through University-Community Collaboration

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COVID-19 HAS AMPLIFIED FOOD, ENERGY, AND WATER (FEW) insecurities across the world and disproportionately impacted Indigenous communities. In the United States, COVID-19 is rampant within the Navajo Nation the largest tribe in the United States, where the rate of poverty (38%) is more than twice that of the state of Arizona (15%). Navajo tribal officials cite the lack of healthy foods and running water as reasons for the prolific virus transmission, resulting in one of the highest COVID-19 infection rates in the United States. The Navajo Nation is a rural food desert, with only 13 grocery stores for a population of nearly 200,000 tribal citizens spread across 27,000 square miles of remote terrain (population density is 8 per square mile, on average). Comorbidities such as diabetes and cancer are prevalent owing to environmental exposure from abandoned mines. Native Americans have the highest rate of diabetes of any U.S. ethnic group, and arsenic-contaminated waters on tribal lands, including the Navajo Nation, increase the risk of diabetes, chronic kidney disease, and cardiovascular disease. Furthermore, nearly 40% of remote Diné (Navajo) homes lack electricity, and more than 30% lack running water. The Diné haul water from potable and non-potable sources 5–50 miles away, incurring an enormous expense of \$13.30 per 100 gallons. These and other challenges make it difficult for Diné communities to respond to and recover from perturbations such as pandemics and disasters.

Resilience is the ability to maintain the desired structure and function of a FEW socio-ecological system under perturbation, such as that associated with COVID-19. Yet outside of health metrics, FEW resilience frameworks often fail to consider Indigenous political, social, and cultural perspectives. Existing resilience frameworks aim to co-manage resources and keep Indigenous people within an unjust and colonial system. Engaging Indigenous perspectives on Indigenous resilience may, for example, improve research on and

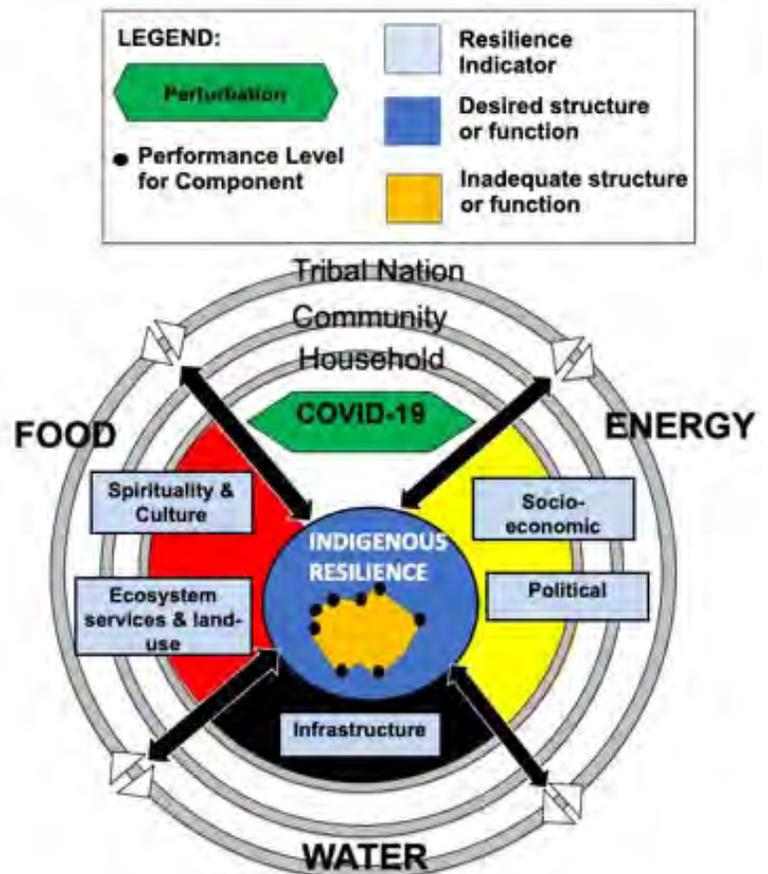


Figure 1. System state under perturbation, placed in a medicine wheel to represent FEW Indigenous resilience framework with indicators at household, community, and tribal nation levels. Two-way arrows signify interactions, and different colors represent Indigenous worldviews and cultural values.

management of sustainable water resources and make it easier to address FEW insecurities among Native American communities. FEW technologies can augment Native communities' capacity to adapt in ways that transform the system state into a desired structure and function, thus increasing resilience at the scale of the household, the community, and the tribal nation (see Figure 1).

Partnerships, including those involving research and education, are critical to addressing FEW insecurities in

Native American communities. Since 2017 the University of Arizona has partnered with the oldest tribal college in the United States, Diné College, to develop a solar-powered water and greenhouse unit to address FEW challenges on the Navajo Nation while training graduate students and tribal college students. This training program is funded through a five-year National Science Foundation Research Training grant entitled “Indigenous

Now, during the pandemic, Indige-FEWSS is working collaboratively with the Navajo Nation to implement first-generation, research-based solar water and greenhouse units at three Navajo chapters, with the goal of household-scale deployment (see Figure 2). Designs are scalable, sustainable, and premised on Navajo priorities. The units will be site-specific—dependent on local water quality, solar characteristics, and population served—but

easily adapted for deployment at other sites. Solar water and greenhouse technology in remote areas can reduce FEW insecurities that have been amplified during the pandemic, thus enhancing Navajo resilience.

Civic engagement with the Navajo Nation in this project involves a multipronged, bidirectional approach connecting community, government, nonprofit, and educational entities across the FEW sectors. These activities emphasize data sharing and transparency; coordination of the co-design, optimization, and deployment of the solar water and greenhouse technology; and

data-driven decision support tools. The Indige-FEWSS partnership engages community members and high school and tribal college students in FEW learning (see Figure 3). Civic engagement builds upon prior collaborations with the Navajo Nation, including the



Figure 2. Diné College students undergo training on the solar water unit, with the greenhouse in the background. Photo credit: Torran Anderson.

Food, Energy, and Water Security and Sovereignty (Indige-FEWSS).” The central goal is to empower Indigenous people with FEW security through water treatment systems and CEA technology that provide skilled jobs and improve quality of life.

Each water treatment unit, powered by solar panels, uses pressure-driven nanofiltration to treat non-potable water and provide water security to approximately 30 families. The brine produced by the water purification unit is suitable for specific agricultural purposes, while the excess energy can be used for nighttime illumination and water heating. The greenhouse unit uses controlled-environment agriculture (CEA) technology to support year-round production of highly nutritious, high-yield food crops. Photovoltaic technologies for light collection, light management, and energy production can enhance CEA deployment, particularly in remote locations challenged with access to power. Two of the solar nano-filtration units were constructed, and one was deployed at Diné College in 2019 for Diné College Land Grant Office’s educational and community outreach purposes. The greenhouse unit at Diné College is under construction.



Figure 3. Earl Tulley shares Navajo cultural knowledge with Indige-FEWS trainees in Blue Gap, Arizona, as part of a spring break culture immersion trip to the Navajo Nation. Photo credit: Mari Clevon.

Gold King Mine Diné Exposure Project. Coordination among partners goes a long way toward breaking down barriers. Sharing the knowledge required to tackle FEW insecurities through culturally appropriate communication is key to building capacity.

The Navajo Nation continues to view FEW insecurities as a priority in COVID-19 response and mitigation. University of Arizona team members have expounded on the role of off-grid technologies to improve water access and quality. For decades, the Navajo Nation has worked with the Indian Health Service on centralized water projects and rural water sanitation projects. Although solar energy is available in a small fraction of Diné homes, off-grid water and food technologies have yet to be implemented across the Navajo Nation. To ensure that FEW technologies are co-designed and appropriate for remote Diné communities and that the technologies are owned and maintained by the Navajo people, involvement of Navajo civic partners is critical. Navajo tribal government programs work to secure funding, provide services, and make FEW policy decisions. Navajo nonprofits on the ground work closely with Diné communities in implementing FEW projects and training. Tribal colleges educate students and community members on FEW. The key goals of these collaborative activities are to (1) share knowledge, best practices, and data that inform decisions and policies, and (2) implement FEW technologies to make a real-world impact while increasing Navajo resilience.

Over time, integrated, connected, resilient FEW units for remote Diné communities will provide efficient, economically achievable opportunities for dispersed water purification capacity and food-producing greenhouse technology powered by solar energy. Through university-community partnerships involving robust community engagement, technologies can be deployed in remote

locations as well as more urbanized locations. Trained Diné citizens will contribute to a diverse and globally competitive workforce and increase the participation of underrepresented minorities in science, technology, engineering, and math (STEM) fields. Resilience will be enhanced by addressing FEW insecurities through a framework that can assist not only the Navajo Nation but other Indigenous and non-Indigenous communities nationally and globally. ■

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