

NWAL Year 7 Final Report



**WATER FOR AGRICULTURE CHALLENGE AREA:
ENHANCING CLIMATE RESILIENCY AND AGRICULTURE
ON AMERICAN INDIAN LAND**



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NATIVE WATERS ON ARID LANDS (NWAL) YEAR 7 PROGRESS REPORT (OCTOBER 2022)

Non-Technical Summary (original from project initiation)

American Indian farmers and ranchers provide an important economic base for rural areas in the Great Basin Desert and arid lands of the American Southwest. Sustaining agricultural production for ceremonial practices, sustenance, and trade is becoming more challenging for American Indian communities due to the scarcity of water resources, rapid change in ecosystem composition and health, and historic land tenure policy arrangements. Climatic change including reduced snowpack and rainfall and increased temperatures, combined with urban and industrial expansion in the American West is increasing demand for a dwindling supply of water from rivers, streams, and underground aquifers. Close cultural ties to natural resources, geographic remoteness, and economic challenges have led some to characterize American Indian agriculturalists as some of the most vulnerable to climate change.

Our project seeks to enhance the climate resiliency for agriculture on American Indian lands of the Great Basin Desert and Southwest by building the capacity within tribal communities to develop and implement reservation-wide plans, policies, and practices to support sustainable agriculture and water management. We will analyze past and future climate risks to traditional and production agriculture and test the feasibility of introducing innovative alternative agricultural practices and water management policies to enhance resiliency. We will accomplish this by harnessing the expertise of research and Extension faculty from 1862 Land Grant Universities (University of Nevada, Reno, Utah State University, and University of Arizona) in partnership with the First American Land-Grant Consortium of 1994 Tribal Colleges and Universities, researchers from the U.S. Geological and Desert Research Institute, and tribal community members from Nevada, Utah, Arizona, and New Mexico.

Our integrated team of research and Extension faculty will partner with American Indian water specialists, cultural advisors, agriculturalists, and educators to collaboratively develop climate scenarios and water supply projections for the tribal lands and surrounding arid areas. Tribal members and researchers will test the effectiveness of existing and future water infrastructure systems to optimize profits and production efficiencies under these climate scenarios. Researchers will study alternative water management policies being adapted worldwide in rural and agricultural areas and assess how these policies could improve climate resiliency in our area. Policy experts and tribal members will assess the efficacy of the federal government's "trust" land tenure system to support or impede tribal water management and agricultural sustainability under the climate scenarios. Researchers will create a set of time series of paleoecological data of tribal land ecosystems and correlate this with climate data to identify extreme events and periods of prolonged climatic change. Interviews with tribal members will be used to gather traditional knowledge about their community's response to these events and the impacts of these events on tribal culture and agricultural production. Knowledge generated and shared through this project will build understanding among tribal and non-tribal organizations about challenges and opportunities for sustaining tribal agriculture and cultural traditions in a changing climate.



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Major Goals (original from project initiation)

The **long-term goal** of this proposed project is to increase the climate resiliency of agricultural production on American Indian lands of the Great Basin region through collaborative generation and analysis of alternative policies, water plans, economic models, and agricultural practices.

Specific objectives to achieve the long-term goal of this project are:

- Increase climate resiliency of tribal communities in Great Basin Desert area
- Increase mutual understanding of traditional ecological knowledge among tribes and research communities
- Increase capacity of American Indian communities to sustainably manage agricultural water resources
- Increase capacity of tribal nations to sustain agricultural and cultural traditions
- Build/enhance tribal capacity to develop reservation-wide plans and policies to support sustainable agriculture and water management/use
- Strengthen 1862 & 1994 Land Grant institution research and Extension partnerships
- Harness FRTEP, 1862 & 1994 Land Grant institution human capital & infrastructure to address climate change issues on reservation lands

Year 7 Target Audience

NWAL outreach to our tribal partners relies on the integration of three critical activities.

- Academic research conducted with and in support of our tribal partners
- Tribal College & University (TCU) Extension Faculty and agents who engage students and faculty in support of tribal community agriculture and who participate in the FALCON network of TCUs to share experiences and best practices

NWAL Target Audiences reached:

- *Tribal Partner Engagement:* NWAL collaborating tribal organizations and tribal government officials and agencies
- *Federal and State Public Agency Engagement:* U.S. Bureau of Reclamation, U.S. Dept. of Agriculture, Bureau of Indian Affairs, U.S. EPA, Arizona Department of Water Resources, Central Arizona Project, Salt River Project, New Mexico Office of State Engineer, NM Interstate Stream Commission, NM State University, Lower Rio Grande Water Users Association, Colorado Water Conservation Board, Colorado Office State Engineer
- *Scientific Community & Water Stakeholders Engagement:* Arizona Farm Bureau, Arizona Cooperative Extension, Family Farm Alliance, The Nature Conservancy, Western Resource Advocates, Sonoran institute, ProNatura, Western Governors Association, Western States Water Council, National Audubon Society.

During the final Year 7 of the NWAL Project we continued our outreach to tribes throughout the United States through the NWAL COVID-19 Action Working Group (COVID WG for short), which was started in March 2020 to address the concurrent emergencies of COVID and climate in Indian Country. In 2021, the COVID WG transitioned to addressing urgent issues associated with the current extreme drought impacting the western US. It met weekly on Zoom with over 200 participants on the invitation list from across the US and Alaska, with participants joining



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from FRTEP, 1994 TCU Extension, 1862 Extension, Ag Experiment Stations, Climate Adaptation Science Center (CASCs), USDA Climate Hubs, and many others.

Highlights of Stakeholder Outreach and Impacts:

- Communications stakeholder engagement:
 - Native Waters on Arid Lands Website: Stakeholders reached: From July 1, 2021-April 22, 2022, the NWAL website was visited by 3,129 unique users (5,473 pageviews).
 - COVID-19 in Indian Country StoryMap: This StoryMap has been viewed 11,701 times. It was also featured in ArcGIS's "Innovative uses of story maps during the COVID-19 pandemic" collection in June 2020.
 - Facts Not Fear Website: Since launching in February 2021, this website has been visited by 1,340 users (5,072 pageviews).
 - COVID-19 Toolkit: Stakeholders reached: Since launching in May 2021, this website has been visited by 280 users (599 pageviews).
- Educator engagement impacts:
 - A total of 160 professional development hours were credited to 15 educators during this module.
 - Following educator engagement, a post-survey was circulated to gauge the confidence level (self-efficacy) of educators.
 - High confidence of participants (83%) to identify and define the CLAIM in scientific argumentation.
 - High confidence of participants (83%) to provide examples of EVIDENCE to support their claim in scientific reasoning.
 - High to fairly high confidence of participants (67%) to identify and define the REASONING in scientific argumentation.
- Student impacts: One graduate student (Brianda Hernandez Rosales) from a group under-represented in the STEM fields completed her Master's thesis as part of this project.
- Faculty impacts: Co-PD Singletary's indirect teaching activities 2021-2022 included ongoing circulation of the 4th National Climate Assessment report (Chapter 15: Indigenous Communities) on which she is a co-author in addition to circulating copies of the STACC Report, Climatic Change article, and Extension Special Publication.

NWAL Year 7 Accomplishments

A reduced NWAL team completed close-out research and Extension activities in Year 7. This included Co-PDs McCarthy and Singletary (UNR), DRI team members Collins, Fitzgerald, Lutz and Bocinsky, and FALCON Co-PD Phillips and consultant Judy Dudley, and Tribal College experts Dupuis (SKC) and RoyChowdhury (NTU).

What was accomplished under these goals? Accomplishments for the project objectives outlined above have been aggregated into four categories (Outreach, Communications & Project Management; Research, Data Collection & Analysis; Tribal College Research, Education & Outreach; and FRTEP Extension and Outreach). Outreach activities are reported below under dissemination of results to stakeholders. The accomplishments listed below represent the

combined effort of many Co-PDs working together and with their respective research, Extension, and education tribal and non-tribal partners. Highlights of NWAL Year 7 accomplishments are listed below. A more detailed report will be posted on the NWAL website.

Impacts of COVID-19 Pandemic on NWAL programs: Due to COVID shutdowns and restrictions in 2020-2022, all in-person events including the NWAL Summit, workshops, training, etc. were canceled or moved virtually. NWAL participants did not travel during the first half of Year 7 with limited travel occurring in spring 2022. We did conduct outreach with Tribal partners, faculty, and students, through Zoom and other on-line platforms, completed most research activities, and published results and outreach materials. All TCUs were closed to in-person education and outreach during the first half of NWAL Year 7. Limited in-person events were permitted at our partner Tribal Colleges (Salish Kootenai College and Navajo Technical University) in Spring semester/quarter 2022.

Meeting COVID-19 Challenges: In March of 2020 the NWAL Team adapted to the COVID-19 pandemic by rapidly transitioning our in-person meetings, workshops, and focus groups to virtual platforms. We also established the NWAL COVID-19 Action Working Group to work with tribes from the Southwest, Great Basin, and Northern Rockies and Great Plains to identify and address urgent COVID-19 impacts in Indian Country. Participation has expanded to include 1994 and 1862 Tribal Extension agents from across the country and Alaska, and other 1862 Extension and Agriculture Experiment Station partners, as well researchers and agency partners. By joining forces from the NWAL network of researchers, FRTEP agents, and TCU faculty, working directly with federal agencies, state and local organizations, and non-profit groups we have been able to address urgent COVID-related impacts in tribal communities. As the COVID crisis evolved, the COVID WG partnered with CDC, HHS, and others to provide information to Tribes to support COVID vaccine education through our newly created Facts Not Fear website: <https://factsnotfearcovid.com>

We have also partnered with the Intertribal Agriculture Council (IAC) to provide regular updates and guidance to the group on CARES Act and American Rescue Act relief funds for Tribal farmers and ranchers. During the Spring of 2021, the COVID crisis morphed into an extreme drought crisis with drought conditions worsening across the western US. Our COVID WG is now focusing on a wide range of topics related to drought impacts on water supplies and agriculture. The accomplishments of this group are a testament to the extensive outreach among diverse communities in Indian Country maintained by our FRTEP and TCU partners, the commitment of NWAL researchers to their knowledge and resources to solving real-world problems, and the dedication of our federal partners at USDA and other agencies who have working tirelessly to help us meet the rapidly evolving challenges created by both the COVID-19 pandemic and now the worst drought on record.

Planning for the sustainability of NWAL through follow-on projects: Several members of the core NWAL project team have pursued additional project funding for NWAL “daughter” projects to sustain engagement with our tribal partners. This is essential to build on relationships with tribal community members, educators, students, agricultural producers, resource managers, and others established during the seven years of the NWAL project. These NWAL follow-on



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projects leverage the investments USDA-NIFA made in NWAL and are exploring new opportunities to further the impact of research, Extension, and education in enhancing the climate resilience of tribal agriculture. NWAL Team members McCarthy (now at the Desert Research Institute), Collins (DRI), Fitzgerald (DRI and UNR), Emm and Hebb (UNR-Extension) partnered on *Native Climate*, a new USDA-NIFA funded project (Award 2022-68015-36357) to expand the impact of USDA Climate Hubs in enhancing climate resilience with tribes in the intermountain west.

Co-PDs and partners McCarthy, Emm and Hebb (UNR-Extension), Teegerstrom (UA), Bocinsky (U. Montana), Lutz (DRI), developed the COVID Toolkit Project that was funded in fall 2020 under USDA/NIFA COVID CARE program (Award 2020-68008-32762) called *NWAL Toolkit Project*. This new project is designed to make research and outreach products from NWAL available to FRTEP agents working in the field with Tribal farmers and ranchers. New resources are also being developed to support Tribal Extension agents in helping their communities deal with the impacts from the ongoing extreme drought. Co-PDs McCarthy, Bocinsky, and NWAL partner Virgil Dupuis (Tribal Extension Director, Salish Kootenai College) applied for and were awarded a USDA-NIFA Conference Grant (Award 2021-67019-33420), called *All Climate is Local*, to share NWAL climate, water and agriculture resources with other TCUs in the Crown of the Continent (MT, ND, SD, and NE). Both of these projects are ongoing and have been converted to be conducted virtually. Co-PD Collins (DRI), was awarded a NIFA Women and Minorities in Science (WAMS) grant (USDA WAMS 2020-02337), called *Teaching Native Waters*, to work with Native 6-12 teachers in the Four Corners region in translate NWAL climate and water research into place-based teaching modules that can be used in classroom.

Research, Data Collection & Analysis

- **Water Resources and Water Quality:** NWAL has partnered with UA and a local non-profit to implement rainwater harvesting with Tribal communities in Peach Springs, Arizona. Peach Springs' climate makes it an ideal location to implement rainwater harvesting systems due to the availability of precipitation during the growing season (North American monsoon). Approximately 7,700 gallons of rainwater can be captured from the 4H building during the growing season in Peach Springs, AZ during a normal precipitation year (~ 9.5 inches). An average area of 645 ft² can be cultivated using the captured rainwater and can yield approximately 178 pounds of maize. Climate projections for precipitation are less certain and show high variability, while temperature projections show an increase in mean daily temperatures in Peach Springs. Climate projections also show an earlier start to the growing season. The cost to implement a basic rainwater harvesting system for outdoor water use on the 4H building to capture rainwater from April - September ranges from \$3,204-\$11,973 USD. Basic materials include polyethylene cisterns, gutters, pump and drip irrigation system. Winter rainwater harvesting is also possible and can capture more than double the volume (16,025 gallons), however, further engineering and materials are need to store the captured rainwater which include additional cisterns, burial or insulation of cisterns to prevent freezing, and disinfection methods. Although rainwater harvesting in Peach Springs, AZ cannot replace current irrigation practices, it can help alleviate some of the strain that is felt



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during this ongoing drought and can help attain a level of food security. Brianda Hernandez Rosalez completed this project under the advisement of DRI team member, Dr. Lutz.

- **Climate data for Tribes.** DRI NWAL team member Bocinsky, updated downscaled climate data for Tribes across the Intermountain West with updated information on drought conditions, seasonal weather and wildfire conditions, and resources available from the North American Drought Atlas, US Drought Monitor, and NOAA/NIDIS. He also trained Tribal partners on climate services available through the Montana Climate Office.
- **Extension outreach and publications:** (For more details see products listed in later in this report).
 - Co-PI Singletary and Fillmore co-authored an extension special publication to report the methods and results of analysis of primary data collected from a 2016-2017 survey of summit participants to assess tribes' climate data and information needs. The Extension Special Publication, *Climate Resilient Tribal Waters*, is available online at (see products listed in this report: <https://naes.agnt.unr.edu/PMS/Pubs/2022-4671.pdf>)
 - Singletary and Fillmore co-authored an article published in *Climatic Change* reporting the highlights of GRA thesis research funded by this project: <https://link.springer.com/article/10.1007/s10584-021-03285-9>
 - Singletary was an invited lead author on a chapter on Economic Development on reservation lands across the US as part of the *Status of Tribal Action on Climate Change Report*, coordinated by U. of N. AZ, ITEP: <https://sites.google.com/view/stacc2021-itep/how-to-access-report?authuser=0>

Tribal College Research, Education & Outreach

Faculty-Faculty Research Partnership (FFRP) program. Upon successful completion and evaluation of the Aaniiih Nakoda College/Desert Research Institute (ANC/DRI) pilot project, a FFRP was implemented with Navajo Technical University (NTU), DRI, and FALCON. The project is a desk-top evaluation of stream “health” in the San Juan River system that crosses the state lines of Colorado, New Mexico, Utah and Arizona and flows through tribal lands. Biological indices were calculated using these benthic invertebrate following the guidance of each states’ regulatory agencies, and the results were compared to evaluate how the sites would be classified in terms of “impairment” by each state’s biocriteria method.

One of the biggest mine-waste (Acid Mine Drainage or AMD) spills in the U.S. occurred on August 6, 2015, when 3 million gallons of AMD water was accidentally released into the Animas River from abandoned Gold King Mine located outside of Silverton, Colorado. The spill temporarily changed the color of the river to orange. The contaminated water flowed down the Animas River, into the San Juan River in New Mexico, was carried into the Colorado River and ended up in Lake Powell in Utah. We have conducted a desk-top evaluation of stream “health” in the San Juan River system that crosses the state lines of Colorado, New Mexico, Utah, and Arizona and flows through tribal lands. In 2016, benthic invertebrate surveys were conducted at San Juan River monitoring sites in the Navajo Nation, and those data are available to the public. Biological indices were calculated using these benthic invertebrates following the guidance of each states’ regulatory agencies, and the results were compared to evaluate how the sites would

be classified in terms of “impairment” by each state’s biocriteria method. Our results showed the nature of resiliency from the microorganisms over the time and their recovery trend.

Promote understanding and appreciation of Native Waters in the Missouri River watershed. Nueta Hidatsa Sahnish College (NHSC), tribally chartered by the Three Affiliated Tribes of the Fort Berthold Reservation in New Town, North Dakota, in collaboration with DRI, University of Montana’s Climate Office, and FALCON secured a NIFA Tribal College Research Grant Program award of \$220,000 for the following project objectives: 1) Develop and test a method by which TCU students can compile comprehensive information about past and present importance of the Missouri River and associated valued resources to their community; 2) Develop and test a method by which TCU students can quantify Missouri River economic benefits in their community (e.g. irrigation, drinking water, fisheries, recreation, flood control, etc.); 3) Develop and test a method by which TCU students can summarize current Tribal Water Programs and relate those to the Pick-Sloan program. (e.g. tribal water policies, river monitoring, climate resilience / flood control planning, assertion of water rights, river access, etc.); 4) Provide additional Student Research opportunities at NHSC; 5) Share tested methods among all 15 TCUs in the watershed; and 6) Host workshop with interested TCUs in the Missouri River watershed to consider formation of a consortium to find ways to pursue common goals and research interests. The project team has developed student internships and coursework and initiated partnership building with other 1994s in the Missouri River watershed.

Climate Extension/Research at Salish Kootenai College. Climate change research and extension projects have been conducted at Salish Kootenai College in order to develop models and best practices for other 1994s, as well as to facilitate new projects. This work includes bison range soil carbon monitoring and range inventory, ventenata pollinator restoration, climate change mitigation, food sovereignty education, tribal climate change lands sector updates, coordination of climate change response for CSKT Climate Change Mitigation Update, wind energy undergraduate research projects, and Safeguarding Natural Heritage project planning and curriculum development.

Outreach to 1994 TCUs and FRTEP. The 1994 TCU Extension network and the 1862 FRTEP network are all included in COVID WG weekly Zoom calls. In collaboration, with NIFA National Program Leader for Tribal Programs (Erin Riley), we hosted virtual workshops to foster collaboration among 1862 and 1994 Tribal Extension programs.

What opportunities for training and professional development has the project provided?

NWAL Year 5 Training and Professional Development:

- **Synergies with Teaching Native Waters educator professional development.** Our team created synergies between NWAL and the Teaching Native Waters program, which is a community of practice that develops and hosts place-based virtual professional development for middle and high school educators serving Native students (USDA WAMS 2020-02337).
 - Kyle Bocinsky provided archeological and paleo-climate content expertise for these modules.

- Karletta Chief shared hydrologic expertise and cultural knowledge for educator engagement and strategic direction of the series.
- Alexandra Lutz incorporated hydrologic content expertise into a new middle school lesson plan on water quality entitled “What Makes Water Drinkable?”. This unit engaged educators in building skills to use the standards-based scientific argumentation (claim-evidence-reasoning framework) in evaluating multiple aspects of water quality, including pH, salinity, turbidity, and bacteria contamination.
- Meghan Collins incorporated training on scientific argumentation (claim, evidence, reasoning) as a key STEM skill into this module.
- **Faculty Supervision:** Co-PD Singletary supervised 1 temp faculty LOA (Fillmore) and 1 permanent faculty (Ilchuk) to complete the Special Publication and a refereed journal article to disseminate research findings to public and resource professionals via hard copy and ADA compliant materials via UNR UNCE website.

How have the results been disseminated to communities of interest?

Outreach, Communication and Project Management

- **NWAL Stakeholder report dissemination:** Co-PD Singletary contracted with a graphic designer and publisher to produce, print, and distribute 500 hard copies of the Extension Special Publication to the 49 Tribes who participated in the survey. The publications should serve to support Tribe’s grant applications for BIA tribal climate planning funds. Hard copies of the report was also provided to Native Waters team members, USDA NIFA program leaders and sponsors, and affiliated project partners.
- **Native Waters on Arid Lands website – <https://nativewaters-aridlands.com>** The NWAL project website documents the work of the team through a blog with project news, links to resources, and links to new NWAL follow-up projects including the COVID-19 Working Group, Facts Not Fear, Teaching Native Waters, and the COVID-19 Toolkit projects.
- **COVID-Climate Working Group –** In March 2020, the NWAL team began hosting weekly video conference calls with Tribal leaders, Federally Recognized Tribal Extension Program (FRTEP) agents, and Tribal Colleges & Universities (TCUs) faculty from across the intermountain west to collect information about the impacts of COVID-19 on tribal farmers, ranchers, and communities and to identify actions that our team or our federal sponsors can take to help lessen the impacts of the pandemic. During fall of 2021, we transitioned the working group from weekly to monthly meetings. The work of this group has been documented in several ways:
 - **COVID-19 in Indian Country Storymap (March 2020 - October 2021) – <https://nativewaters-aridlands.com/covid19>** - This website documents the work of NWAL’s COVID-19 Working Group from March 2020 to October 2021, including impact maps, a list of urgent issues, COVID-19 response projects, resources, presentations, and more.
 - **COVID-Climate Working Group web page (October 2021 – present) – <https://nativewaters-aridlands.com/working-group/>** - Recordings and presentations from these monthly meetings are now housed on this COVID-Climate Working Group page, where they are organized by topic.

- **A feature story on the DRI website (July 2021)** – “From COVID-19 to Drought: Collaborating on Emerging Challenges Across Indian Country”.
<https://www.dri.edu/from-covid-19-to-drought/>
- **Facts Not Fear website - <https://factsnotfearcovid.com/>** “Facts Not Fear” is a website and information campaign developed by NWAL’s COVID-19 Working Group to supply Tribal members and Tribal Extension Experts across Indian Country with accurate information and educational resources about the COVID-19 vaccines. The website contains answers to questions that were gathered from our project partners during weekly calls organized by the COVID-19 Working Group, vaccine information for tribal youth, mental health resources for tribal farmers, and other resources aimed at tribal communities.
- **COVID-19 Toolkit - <https://nwaltoolkit.com/>** The COVID19 Toolkit website allows users to submit drought impact reports documenting Blister Beetles, Weevils, and Grasshoppers, impacts to livestock, and impacts related to monsoon and soil erosion. It also contains environmental data and other place-based resources for tribal extension agents and agricultural professionals.

What do you plan to do during the next reporting period to accomplish the goals?

This was the final year (Year 7) of the NWAL Project. See above for follow-on project descriptions.

Year 7 Problems/Challenges Addressed

The major impact resulted from the COVID-19 pandemic. During Year 7 UNR returned to in-person or hybrid teaching, research, and Extension by Fall 2021 but the Tribal Colleges remained closed until Spring 2022. The use of virtual communication platforms allowed the NWAL team to engage more communities from around the country through the NWAL COVID WG and other virtual events. NWAL and follow-on project team members were able to plan for a combination of in-person, virtual, and hybrid events starting in 2022. Limited travel by remaining project personnel was permitted in the first half of 2022.

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	1.8	1.0	1.0	0	2.8
Professional	0.5	0	0	0	0.5
Technical	0.4	0	0	0	0.4
Administrative	0	0	0	0	0
Other	0.2	0	0	0	0.2
Computed Total	2.9	1.0	1.0	0	4.9

 **Native Waters** on Arid Lands**Student Count by Classification of Instructional Programs (CIP) Code**

Undergraduate	Graduate	Post-Doctorate	CIP Code
1	1		03.02 Natural Resources Management and Policy.

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