FEATURE

It Takes a Team: Tackling Water Quality Challenges and COVID-19 in the Navajo Nation

Joseph H. Hoover, Daniel Beene, and Karletta Chief

At Waterfall Spring, an unregulated water source on the Navajo Nation, water is collected and funneled to watering troughs downhill of a spring. Source: Joseph H. Hoover.

IN 2020 SCHOLARS FOUND THAT A LACK OF INDOOR plumbing was associated with a higher rate of COVID-19 cases in Indigenous communities in the United States. Among the affected populations is the Navajo Nation, whose territory spans northeastern Arizona, northwestern New Mexico, and a small portion of Utah. To learn more about the role of water access in the spread and transmission of COVID-19, the Navajo Nation invited water experts from multiple academic institutions to join the nation's Water Access Coordination Group (WACG).

In collaboration with the Navajo Nation, researchers applied a team science approach to the issue, bringing together a group researchers and students from a wide range of fields. Together, they not only answered important questions about water access and COVID-19 risk but also developed a valuable tool for assessing water quality more broadly—critical in a region dotted with thousands of unregulated groundwater sources.

Teaming Up

The first step was assembling the right team. We brought together a multidisciplinary cohort of researchers and students from the University of Arizona; Northern Arizona University; the University of New Mexico; the University of California, Los Angeles; Montana State University Billings; the Southwest Research and Information Center; and the Navajo Nation Department of Water Resources.

To tackle this complex problem, we had to approach it from many angles. The multidisciplinary makeup of the team was essential to success—it included experts in Indigenous resilience, water science and chemistry, health science, geography, community-engaged research, and water policy.

Together, we compiled existing datasets from public sources that help shed light on how water access—or the lack thereof—affects the transmission of COVID-19 in the Navajo Nation. This approach allowed us not only to formulate rapid responses to the Navajo Nation's current needs but also to identify data gaps that future investigations should address.

For the data to be effective, they had to touch on many variables. Thus, faculty, undergraduates, and graduate students developed and populated a database with information from multiple sources and geographic scales (household, chapter, and service unit). The data included:

1. sociodemographic, economic, and built-environment data for Navajo chapters from the American Community Survey,
2. geographic information system (GIS) data derived from network analysis using de-identified household location information provided by the Indian Health Service and OpenStreetMap, and
3. publicly available COVID-19 case counts for IHS service units from the Navajo Nation COVID-19 data dashboard.

The research team also added water quality information to an existing database built and maintained by the Community Environmental Health Program at the University of New Mexico.

After compiling the data, the team ran a preliminary analysis of the relationship between risk factors and COVID-19 case rates on the Navajo Nation. Preliminary results suggest a correlation between COVID-19 case rates and language spoken at home as well as opportunities to further explore the role of water access with COVID-19 transmission. These results were presented to the Navajo WACG and at the 2021 Navajo Research Conference.

But the COVID-19 results were only the first step of this project. The team next turned to developing an Internet-based GIS to allow potential users to get access to the compiled water quality dataset and to visualize the data in helpful ways.

Putting Data in Perspective

The task of compiling all the data on unregulated water sources in the Navajo Nation was nearly as large as the nation itself—an area that encompasses more than 71,000 square kilometers in three states. The Community Environmental Health Program at the University of New Mexico first took up the challenge in 2011, when it started compiling existing water quality datasets into a single database. The database emphasized unregulated water sources for several reasons: these sources are not regularly monitored for quality, and they are used by Navajo Nation residents for watering livestock, domestic use, and more.

Our team built on this effort. With support from the Agnese Nelms Haury Program in Environment and Social Justice, we began adding new details to the picture that the Community Environmental Health Program had sketched in 2011. In 2020, we added approximately

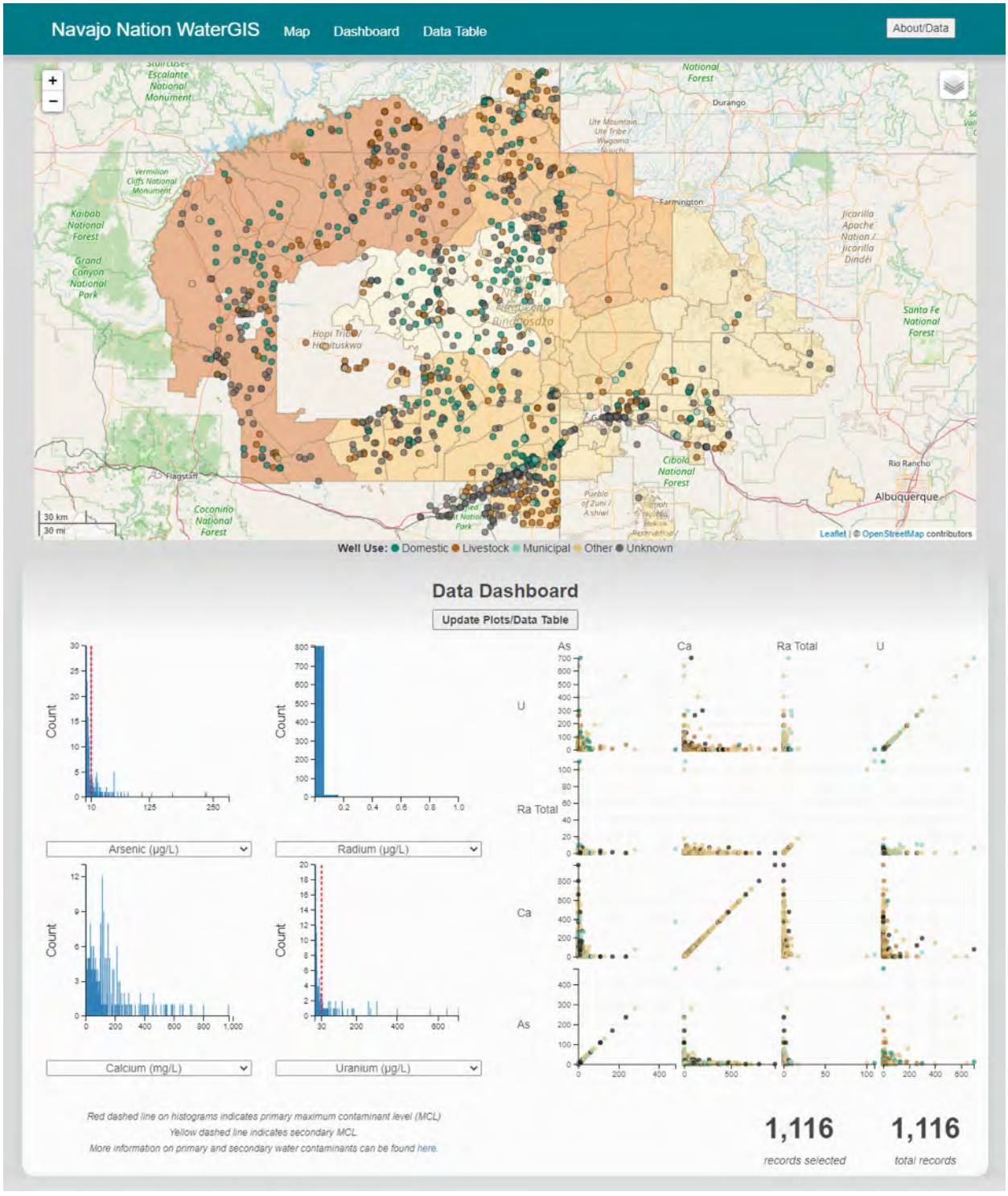

Figure 1. The Navajo Nation WaterGIS application includes a map interface (top of the figure) and a data dashboard (bottom of the figure) so that users can visualize and analyze distributions and occurrence of water quality parameters. (This figure illustrates publicly available data only.)

1,300 unregulated groundwater sources, bringing the total covered to more than 2,000. With the help of students from multiple tribal nations and universities, we were able to collect the data and incorporate it into the existing database housed at the University of New Mexico. By making these additions, we updated the database to include information on almost all chapters in the Navajo Nation.

Getting Interactive

Without a way to access, navigate, and interpret the data, it was of little use. Our next goal was to develop tools to help stakeholders and researchers get a grip on this massive amount of information. We updated the metadata—searchable terms—for the dataset to help researchers and community stakeholders make use of it. We also made the data accessible and interactive: we designed the Navajo Nation WaterGIS portal (Figure 1), a web-based application, to give users a chance to engage with water quality data.

The intended user community is diverse: we wanted the app to be useful to Navajo Nation residents as well as regulators and government officials. The app's functions will make it a versatile tool in the hands of policy makers and stakeholders, allowing them to change the map format between satellite imagery and roads, or a hybrid of both. Users can also overlay the point locations of abandoned uranium mines and major towns of the Navajo Nation.

Moreover, users can change the graphical display by filtering through a list of metals and metalloids known to affect human health and can update the map by displaying concentrations of interest in the data dashboard. All data in the public-facing web app is fully documented and available for download. The application is deployed through the University of New Mexico domain.

This project began with a focus on the relationship between water access and COVID-19 transmission rates—but it has the potential to do much more. As our collaboration with the Navajo nation continues, our picture of water access and quality among Navajo communities will grow clearer. Our interactive data dashboard and web map interface will continue to provide access and visualization for Navajo Nation residents, government officials, and future researchers. ■

Contributions

This project synthesized multiple research objectives and approaches from a diverse interdisciplinary team, whose efforts and expertise the authors would like to recognize here: Randall Akee (rakee@ucla.edu), Ricky Camplain, (Ricky.Camplain@nau.edu), Stephanie Russo Carroll (stephaniecarroll@arizona.edu), and Joseph Hoover (joseph.hoover@msubillings.edu) integrated COVID-19 risk factor and case count data. Undergraduate students Rusty Butler (rustybutler93@gmail.com), Madisan Chavez (madisanchavez4@gmail.com), Destinee Gondara (destineegondara12@yahoo.com), and Brianna Gray (brigray4961@gmail.com) worked with graduate students Nikki Tulley (nikkitulley@email.arizona.edu) and Daniel Beene (DaRBeene@salud.unm.edu), as well as with Joseph Hoover to compile and harmonize water quality data provided by Jani Ingram (Jani.Ingram@nau.edu), Chris Shuey (sric.chris@gmail.com), and Johnnye Lewis (jlewis@cybermesa.com). Guidance regarding Navajo government perspectives was provided by Crystal Tulley-Cordova (tulley-cordova@navajo-nsn.gov), and Indigenous environmental health perspectives were informed by Karletta Chief (kchief@email.arizona.edu) and Johnnye Lewis. The Internet GIS application was built by Daniel Beene. All team members provided feedback on public presentations and reviewed this manuscript. Funding to support this work was provided by the Agnese Nelms Haury Program in Environment and Social Justice, and the National Institutes of Health through the UNM Center for Native Environmental Health Equity Research (P50 MD015706) and METALS Superfund Research Program (1P42ES025589).

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