

PART 1

EDUCATORS

GIS TECHNOLOGY IS CENTRAL TO DEVELOPING THRIVING communities and solving the world's most pressing environmental and social problems. Using GIS, students and scholars collect spatial data, investigate trends, predict change, compare scenarios, and propose solutions. This work doesn't simply result in additional knowledge and skills: it often leads to action by students and faculty, and even by the wider community, that leads to greater opportunity, health, resiliency, and sustainability. In this way, leading colleges and universities prepare students for meaningful careers and advance our understanding of people, places, and processes, from the local to the global scale.

In geography and geographic information science

GIS provides modern, industry-standard tools and methods for your classroom exercises and projects, whether in geography or geographic information science (GIScience). Students use the same industrial-strength GIS software used by the institutions looking to hire them after graduation. Whether you're teaching GIS fundamentals or advanced concepts, from map design and spatial analysis to machine learning and data collection using remotely piloted aerial vehicles, such as drones, a wide array of resources and GIS lessons are available to help you succeed as an educator.

Across the curriculum

You can find such resources even if you are using GIS as an instructional tool to teach another subject, such as earth or environmental science, history, mathematics, data science, engineering, or urban planning. Maps and location analytics enhance scholarship in dozens of fields by revealing patterns and relationships. These insights improve understanding and decision-making in both natural and human systems. GIS provides an integrated system for data collection, analysis, and publication that's also open and extensible. Enable access throughout your institution with enterprise licensing backed up by support and training and best practices shared by your peers.

GIS in action

This section looks at real-life stories about how students and faculty use GIS to make a positive difference on their campuses and beyond. These include addressing the serious problem of food waste, investigating areas where environmental justice is most needed, building a geospatial legacy in research and development, designing a tool to help people know whether water is safe to drink, revitalizing an urban center, incorporating GIS in K–12 education, and fostering geographic literacy with exceptional learners. These stories show that spatial thinking is being nurtured through the application of GIS on campuses across the world, from primary schools to university students, and across many disciplines.

GIS PROJECT HELPS WITH FOOD INSECURITY AND WASTE

Palomar College

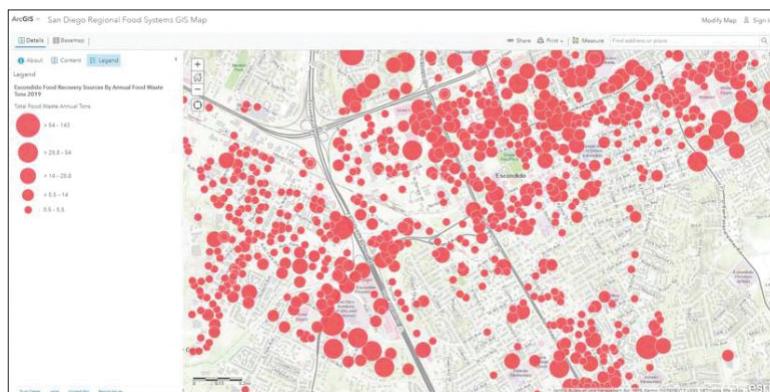
ACCORDING TO THE UNITED STATES DEPARTMENT OF Agriculture (USDA), Americans throw away 30 to 40 percent of the entire US food supply.

At the same time all this food is wasted, according to research conducted by the USDA and released in 2018, 11.8 percent of Americans struggle with hunger daily and one in six children live in food-insecure households. These numbers represent conditions before the massive unemployment caused by the COVID-19 pandemic, which exacerbated the problem.

A geography professor at a Southern California college developed a community-based service-learning project that originally focused on addressing food insecurity. However, the project has expanded and now supports strategies for addressing other equity and social justice issues, implementing state restrictions on solid waste disposal, and mitigating climate change.

In 2014, Wing Cheung, a professor of geography and environmental studies at Palomar College in San Marcos, California, met with Craig Jones and Geertje Grootenhuis, representatives of local nonprofit organizations, to discuss how GIS could help address food insecurity and other equity and social justice issues through the community-based service-learning projects that Cheung envisioned for his students. Initially, he discussed using GIS to help minimize food waste.

Jones was instrumental in founding the Alliance for Regional Solutions, which coordinates and advocates for communities in the North County region of San Diego County, and the North County Food Policy Council (NCFPC), a member of the Alliance for



Total food waste from 2019 in tons in San Diego County, mapped by location.

Regional Solutions that assesses and supports the creation of programs to ensure that residents of North County have adequate food. Grootenhuis is the manager of the Wasted Food Prevention Program at the San Diego Food System Alliance (SDFSA), a network of more than 100 organizations working to make the current food system more equitable, healthy, and sustainable.

“After speaking with Professor Cheung, we realized that GIS could be a very useful tool for the NCFPC,” said Jones. “It would allow us to better understand the nature and extent of food insecurity and the resources to address it—both existing and needed.”

The State of California had recently enacted laws requiring that cities and counties reduce solid waste and reduce or recover food now in the waste stream. Communities are also required to reduce greenhouse gas emissions, which decaying food creates, because of their adverse effect on climate. To ascertain the amount of food wasted locally, the SDFSA established contact with cities in the region to obtain weekly solid waste data for local businesses.

This data is then used to calculate the tons of food waste

generated by local businesses on an annual basis. Ultimately, the datasets are provided to GIS students at Palomar College to geocode and analyze. This data is visualized as point data that is categorized based on state land-use codes and the quantity of wasted food generated at that location.

“Having this information in GIS helps our local cities address the state’s mandate to plan and reduce or redirect food waste. So far, approximately half of the municipalities in San Diego County have their datasets on our GIS platform, and we continue to engage in discussions with other local cities on how they may take advantage of the platform themselves,” said Jones.

“The Wasted Food Prevention Program provides technical assistance, consumer education, and network development to raise awareness about the issues of food waste,” said Grootenhuis. “Our alliance between SDFSA, NCFPC, and Palomar College has opened up the powerful analytical capabilities of GIS to us. With its custom mapping tools, the technology also allows us to clearly depict the local issues that contribute to food waste, which helps prevent good food from ending up in the landfill.”

The project was fully implemented in the fall semester of 2015. Cheung’s students in his introductory GIS class began by geocoding the spreadsheets created by NCFPC that detailed its partners’ locations. Semester by semester, both beginning and advanced GIS students at Palomar added data layers and updated existing ones. For example, students mapped the participation rate in free and reduced-price lunch programs in San Diego County schools.

Over the years, Palomar College students have used ArcMap™, ArcGIS® Pro, and ArcGIS Online to process, analyze, and share the data they received from community partners. The data is provided by a variety of sources, including local government agencies, school districts, and other community agencies in the region.

Although the project started with data layers that covered only North County, over time the value of this information has attracted the attention of local governments and nonprofits from all over San Diego County, so relevant data layers that include the entire county have been created and added.

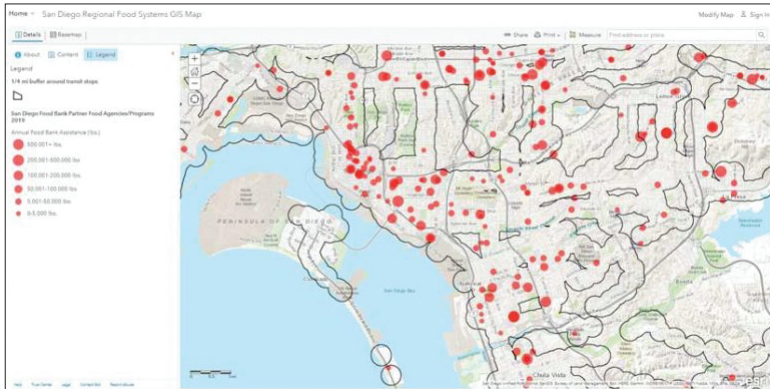
This is particularly important because the SDFSAs has substantial regional connections and the resources to market the value and use of the map throughout the region. The web map has received thousands of views and has nearly 50 layers, which can be turned on and off as needed.

Since its beginning, the partnership between NCFPC, Palomar College, and SDFSAs has evolved in response to the needs of communities in the region. These service-learning projects demonstrate how GIS can enable educators to build partnerships with community organizations to address many more real-world problems. The program began by mapping existing food assistance programs and sociodemographic data to serve those in the region who suffer from food insecurity. Today, it has expanded to explore opportunities to address issues such as food waste, climate change, and transportation challenges while continuing its focus on food insecurity.

“We have found that using GIS provides us with insight into social services and equity issues far beyond the issue of food insecurity,” said Jones.

The Alliance for Regional Solutions is now pursuing a grant from the State of California for planning transportation systems for disadvantaged populations living in San Diego’s North County. Maps that Palomar College students have made showing the location of disadvantaged communities in relation to their current public transit options will provide the justification for the grant.

To facilitate the application process, Cheung and his students provided Jones with a data layer of census tracts in ArcGIS Online,



This map shows the locations of San Diego Food Bank partners, their proximity to transit stops, and the amount of food assistance they provide annually.

which enabled Jones to create custom maps that highlight the transportation needs specified in the grant proposal.

“Those involved in social justice issues in San Diego County are learning that GIS tools can be used to analyze and visualize pressing regional problems,” said Cheung. “The projects developed by our partnerships with local agencies require students to apply their classroom knowledge of GIS to research, analyze, and solve real-world problems related to food insecurity and food waste in San Diego County. The program also enhances the students’ communication skills, as well as their awareness of social justice and equity issues in the community.”

A version of this story by Jim Baumann originally appeared in the Fall 2020 issue of *ArcUser*.

MAPPING FOR EQUITY AND ENVIRONMENTAL JUSTICE

Equity Research Institute, University of Southern California

WHEN MANUEL PASTOR FIRST SAW THE MAP SHOWING how clearly the population of South Central Los Angeles (LA) in Southern California had shifted, his first instinct was to show someone, because, he said, “I bet their jaw will drop.” In just a few decades, the area’s majority Black population had become an overwhelmingly majority Latino population.

The map image—one that’s tailor-made for a generation accustomed to GIFs—shows those stark changes over time in a quick animation and acts like a visual thesis for Pastor’s latest book, *South Central Dreams*. It’s also a keen example of the power of maps in his research.

“When you show people a map, the story is so much stronger, the communications piece is so much better,” Pastor said. The result can leave a viewer stunned. “That’s the punch you want with the story.”

The University of Southern California (USC) sociology professor and director of USC’s Equity Research Institute has spent his academic career working with community activists and diving into numbers, spreadsheets, and data tables to expose inequities and promote environmental justice. He and his team of researchers also use GIS to visualize and analyze demographic and economic shifts and create the maps that share those findings.

Pastor’s work with colleagues developing an Environmental Justice Screening Method is now part of California’s CalEnviroScreen process, a mapping tool that helps the California Environmental Protection Agency identify communities most impacted by multiple environmental, social, and health hazards.

The Environmental Justice Screening Method has also been used by officials for Los Angeles County to help identify Green Zone neighborhoods—those in need of environmental remediation and investment.

Still seeking equity after all these years

Despite decades of palpable political awareness of environmental justice issues, solutions have only recently been incorporated into bureaucratic processes in California, Pastor said. Community activists, who were accustomed to wrangling their way into agency meetings to discuss environmental justice actions, are now often invited to participate at the onset. According to Pastor, there's been a realization that the earlier people are involved in solutions, the more amenable they'll be to the result. There's a sense of ownership.

Pastor has also recognized how important it is for social organizers to communicate closely with data managers within organizations and governments. The connection serves to effect change and foster what he calls “nerd to nerd” relationships.

After he coauthored a landmark 2007 study, “Still Toxic After All These Years,” Pastor said researchers with the Bay Area Air Quality Management District backed up his research to naysayers, confirming the conclusions.

In that study, he helped show that, even controlling for wealth and land use, race played a larger role for a Bay Area resident living near environmental hazards. The report found that a Black family earning more than \$100,000 was more likely to be living near a toxic waste facility than a white family earning \$25,000.

In his latest book, Pastor and his coauthors looked deeply at South Central LA's population shifts.

“It's maps, it's data, and it's a qualitative story,” he said of the book. “It does something else, too. It goes beneath the flash and fury

to the daily lives,” he said, referring to what has happened since the early 1990s. At that time, the area was an epicenter of violent divisions and had become synonymous with crime and blight. Although plenty of progress has been made since, Pastor said, stories about Black and Hispanic neighbors getting along in the community and forging common interests and collective organizations are not seen as newsworthy as the preceding conflict.

Building knowledge communities

Pastor grew up in La Puente, California, in a neighborhood bereft of greenery, near toxic hazards. It took trudging across hot asphalt to get anywhere and searching two towns over to find a public swimming pool.

While that kind of life experience can affect people in different ways, it often has a psychological impact, Pastor said. “It’s insulting to be in a place where no one is planting trees. Where there are no parks. It is every part of the built landscape that is screaming at you that you are less than.”

The more we can create buffers between homes and nearby industry with natural features, he said, the more positive health outcomes there will be—including self-esteem and community esteem.

In *Equity, Growth, and Community: What the Nation Can Learn from America’s Metro Areas*, Pastor and his coauthor, Chris Benner, point to evidence that communities reliant on robust data sharing were better off. In their analysis, such locales were more equitable, and as a result, had more sustainable growth. In these “knowledge communities,” he said, people were on the same page.

“Our ability to grow together may be fundamentally rooted in our ability to know together,” he and Benner wrote in their book. Knowing where people are located has been instrumental to Pastor’s work with social advocacy.

In the 2012 and 2016 presidential elections, he recognized the potential power of maps on voting outreach. By using an underlying answer in the census to estimate where recently naturalized citizens may be living, he helped give get-out-the-vote groups a guide to reaching immigrants.

They were simple maps but are still among Pastor's favorites. "Any map that changes the world to be a better place is a good map," he said.

Reasons for optimism

Despite his upbringing among environmental hazards and his long pursuit of equity, Pastor remains optimistic that better days lie ahead.

There's a streak of beating the odds in his life. For one, the university professor is the child of an undocumented immigrant with a sixth-grade education and a mother who reached 10th grade before leaving school.

He's also lived through three decades of difficult social movements. Many of those pursuits, including workers' rights, commitments to climate change intervention, community improvements, and shifting political representation, ultimately came to some fruition.

There remains dramatic inequality in our society, Pastor said, but "there's a willingness to deal with it."

A version of this story by Steve Gay originally appeared as "For Equity and Environmental Justice, USC's Manuel Pastor Knows Maps' Power" on the Esri Blog on September 23, 2021.