GIS use by Ohio county governments

Jennifer Mapes and Noelle Spence
Kent State University
Community Geography Laboratory

August 2025

Executive Summary

A digital divide between rural and urban America persists, if only because of economies of scale: it is harder to support technical staff in counties with a smaller budget. Our interest was in the extent to which geographic information systems are being used in local Ohio government. There are GIS professionals working in the county government in nearly all of Ohio's 88 counties. While counties with larger populations, unsurprisingly have robust GIS presence in terms of staff and online, we were interested in how smaller counties are faring. We found more GIS staffing and use than we expected, with 65 percent of counties employing more than five full-time GIS professionals. However, based on the survey and on an analysis of county GIS websites, we also found a heavy focus on a single theme: allowing users to view tax parcel data. There was less emphasis on social and environmental data viewing, and less still on making these data available for download. Our research suggests that while GIS professionals working for local government are interested in the opportunity for more training, local GIS clearinghouses that support local government, and other organizations could be equally valuable for boosting the use of GIS at the local level.

Table of Contents

Introduction

Computerized mapping using geographic information systems (GIS) has transformed urban planning, emergency management, environmental science, and economic development. But not all communities have equal access to the data, software, and personnel needed to take advantage of this transformation. Research on this specific digital divide is limited and aging. This report is a first step in working to identify and improve the GIS capacity and data transparency of small towns and rural counties in Ohio.

Our plan is to use this data to build a GIS hub that would provide free or discounted mapping services and offer a website with accessible, targeted data for communities that otherwise have limited access to GIS. Our goal is to reduce barriers to GIS use by providing a GIS data-sharing cooperative. We also foresee a future partnership between local governments and the university, where we could offer workshops and GIS bootcamps. These projects would serve rural Ohio and be a model for other university-government partnerships. This report is a preliminary examination gauging interest in this approach at the county level.

Background

Compared to large cities and wealthy suburbs, small rural communities have less (and sometimes zero) access to GIS staff and data (Neal and Vettraino 2023; Elwood 2006; Robinson et al. 2017; Li et al. 2020; Barkley 1998). This puts them at a disadvantage for regional, state, and national grants. More importantly, a lack of digital spatial data makes it more difficult to learn more about their community, to target projects to assist vulnerable groups, and to prepare for emergencies and hazards (O'Looney 2000). A lack of access to GIS also makes it harder for local advocacy groups to identify and respond to social and environmental problems.

Layering data on maps is not a new concept (Cloud 2005), but computers made this easier and allowed for more data and greater efficiency. Development of computerized mapping tools began in the 1960s, and the first GIS software company, Environmental Systems Research Institute, Inc. (ESRI), was launched in 1981. Astonishingly, few competitors emerged in the nearly half-century following and ESRI remains the dominant GIS software. According to their Quick Facts website, "50% of Fortune 500 companies, most national governments, 20,000 cities, 50 US states, and 7,000+ universities rely on Esri technology." Open-source GIS software (QGIS) is available, but most professionals are trained using ESRI software because of job market demands.

ESRI software (specifically ArcGIS Pro) is used for everything from creating basic location maps to complex spatial analysis. For municipalities, there is great power in these mapping tools. While all cities and villages likely have maps of roads and zoning, only those with GIS software and training can quickly and easily layer these data with classified wetlands, property vacancies and demographic data to ask spatial questions. The speed at which data can be called up, analyzed, and shared makes GIS an essential tool for emergency management. During a specific event (flood, tornado, winter storm), emergency managers can determine who is most at risk based on where they live. They can also find out who is most socially vulnerable and may need special assistance. GIS is particularly attuned to answering questions like these about intersecting environmental and social challenges. Originally developed to focus on environmental issues, GIS can help cities identify the best areas for parks, street trees, trails, or natural corridors by combining data about existing environmental features, protected lands, and wildlife habitats. Additionally, GIS can offer guidance for economic development by identifying parcels that meet a developer's needs in terms of land but also nearby customer or workforce demographics.

To create maps and conduct these analyses, cities and other organizations need spatial data -- features that are connected to a street address or latitude and longitude. As most GIS users can attest, one of the most challenging parts of creating maps from scratch is finding this data. Social, economic, and environmental data is spread across government agencies of all scales, non-profits, and other online sources: only in large cities is there a single site dedicated to hosting data. Even then, the data must be georeferenced (that is, tied to a specific latitude and longitude) and be from a reputable source. It often must be *cleaned* to be successfully added into GIS software, including deleting or calculating columns, manipulating data to account for population, and other modifications. It then must be *clipped* or cropped to only include data from the target municipality. While they may have an internal server that hosts these data, most cities and villages do not provide them in an easy-to-access location that is accessible to the public. The easier these data are to access; the more power community organizations have to study and advocate around social and environmental justice issues.

In the early years of GIS, geographers raised concerns about a digital divide where only the wealthiest communities could afford GIS software (today it costs about $3,000 a year) and personnel. There is far less concern today and many assume the use of GIS to be ubiquitous. However, even in our own college town of Kent (population about 30,000), there's a lack of access. Until recently, the city did not have a GIS software license, and instead outsourced projects to a local environmental resource company's GIS department. The city did not use GIS for redistricting its wards, making it a time intensive process. Kent has no dedicated website where spatial data can be downloaded. When asked for spatial data, staff typically send PDFs or AutoCAD files, neither of which are easily compatible with GIS. Our experience has shown access is even more difficult in less wealthy parts of the region. Yet these are some of the places

that would most benefit from a close analysis of economic, social, and environmental challenges.

Problem & Opportunity

The digital divide is often discussed as a lack of connection to an internet network but extends far beyond this into the ability to use this network to its fullest capacity. Similarly with living in an era of "big data" this has an uneven impact on communities if that data cannot be easily accessed and processed due to a lack of tools, skills, or software. Rural Ohio counties suffer from economies of scale: that is, unlike larger counties, their total budget does not allow for any or more than one GIS professional to spread across expenditure areas including public health, environmental protection, education, and transportation planning (for example). These counties would benefit from sharing a single public health GIS professional, a single environmental protection GIS professional, etc., however that is not how counties operate. So many smaller counties have only one stand-alone GIS professional who must try to cover multiple topics and is spread quite thinly.

As a public institution with extensive GIS resources (software, skilled users and analysts, and educational programs), Kent State is in an excellent position to assist these GIS professionals and bridge the digital divide. Community Geography, as a subdiscipline and methodological approach, is available to provide this support. Community Geography is part of this trend. This approach builds on earlier work of applied geography, citizen science, public participatory GIS, and feminist geography to embrace the responsibility of geography in working with the local community to co-create spatial knowledge, produce maps, and support social and environmental justice. Essential to this collaboration is co-produced knowledge: valuing what we can learn from our neighbors as part of our work as teachers and researchers.

After a century or more as an "ivory tower," the 21st century university increasingly recognizes its responsibility as a force of good within the community where it is housed (Mapes et al. 2017; Shannon et al. 2001). Colleges are investing in service to their surrounding neighborhoods, and working to integrate research, teaching, and service into a mutually beneficial relationship within their community.

Given the challenges faced by communities that need GIS and the plentiful resources available through the university, our research seeks to identify areas of need and how Kent State University may be able to fill this gap.

Our research asks:

- What staffing support do Ohio county governments have for GIS data collection, management, analysis and presentation?
- What aspects of county government is GIS data, software, and staffing used?

- What additional support, if any, can a regional university like Kent State provide to assist with GIS software and skills?
- To what extent do county governments make GIS data available to the public?

Methods

We took advantage of a connection to the County Geospatial Association of Ohio (CGAO) to reach out to county GIS coordinators with an online survey, followed up with interviews and online content analysis of government websites. The survey was sent to GIS coordinators in 86 of Ohio's 88 counties by Gabriel Durrant, a graduate of Kent State's Master in GIS program and founder of the CGAO.

The survey asked a few brief questions, specifically:

- How many employees use GIS on a regular basis?
- Is all GIS done in-house or is some contracted to outside vendors?
- What departments use GIS for mapping or analysis?
- Does your city provide GIS data online?
- What (if anything) limits your ability to provide GIS data online?

We also asked if the respondents would be willing to discuss their answers further in a phone interview that would last half an hour to one hour. These interviews asked for further information about the use of GIS software and digital spatial data, GIS staffing and skills, and the provision of open data online.

In examining our initial results, we decided to add an additional data source: county GIS websites. These websites provided us with a better understanding of what survey participants meant when they said that, yes, they "provide GIS data online." Our research took into account that some website users may be interested in seeing GIS data presented through an interactive map, while others may be want to download spatial data to view and analyze on their own. We were also interested in what type of spatial data was shared by the county government. A content analysis of each website allowed us to provide more nuance in answering questions about open data at the county scale.

In December 2024-January 2025, we looked at what data was made available through a "GIS Viewer" interactive map and what data was made available for download. We identified the most common types of data, and then counted how many of these types of data were available on each county's website. The most common types were parcels, roads, aerial images, special districts, hydrology, and county subdivision boundaries. This approach offers a rudimentary understanding of open spatial data at the county scale: further research is needed.

We also acknowledge that this approach to studying rural and small-town use of geospatial technology only gets us so far, as it focuses on the **most likely part of government to have GIS access**. Follow-up research will look at smaller units of government, particularly in rural areas, to consider to what extent they use GIS to provide government services. We expect that these towns and cities rely on county government and outside contractors, since many do not have GIS access themselves.

Results

By triangulating multiple data sources, we determined that most counties have at least one GIS professional on staff, but few have more than ten. Most GIS data collection and management by counties is focused on land records and elections, with a few using these tools for environmental, economic development, or the provision of social services. Nearly all county websites included a GIS viewer for tax parcels, but many did provide data (to view or download) beyond this online offering.

Surveys

Surveys were sent out in July 2024 to the GIS coordinators from 86 counties in Ohio and 35 counties responded. All respondents had at least one person on their staff that uses geographic information systems (GIS), which was not surprising given the. When asked about access to and licensure for ESRI products, 89% of respondents indicated they work for a county or municipality that has an ESRI license. The number of city employees that regularly use GIS ranges from one employee to more than 100 — one respondent reported public access to GIS, likely through ArcGIS online. Though there was a wide range of GIS use reported, in most cases respondents reported 4-5 employees use GIS on a regular basis (Figure 1).

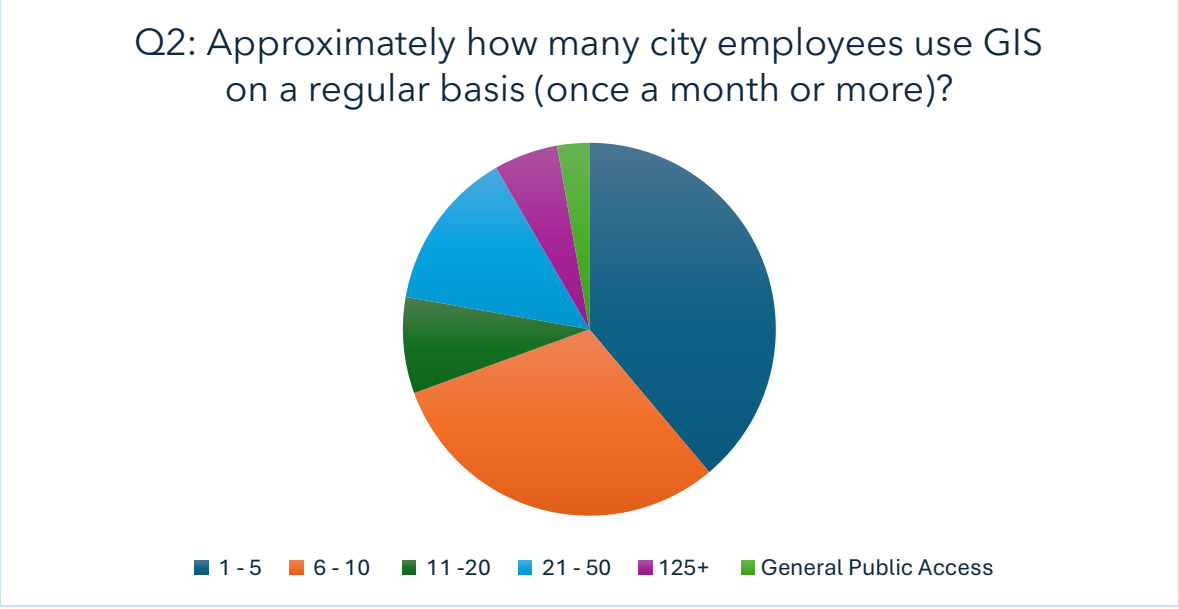

Figure 1: Survey responses indicating number of county staff using GIS

All respondents reported GIS use in their counties, not surprisingly since the survey was sent out to a county GIS staff organization. However, the number of employees in each county with a job description similar to 'geospatial data analysis' ranges from 0-15. Most frequently 1-2 employees were reported as GIS professionals. Departments that require GIS technologies or GIS professionals included Land Administration and Land Records, Elections, and Emergency Management and Services (Figure 2). Land Administration and Land Records departments were most likely to contract with other outside agencies for GIS work, including providing information to the public about parcel ownership. Emergency Management and Planning departments are also likely to contract with outside agencies. For elections, redistricting of local districts requires fine-scale analysis of population and population change, with municipalities required to create precincts of similar population every ten years.

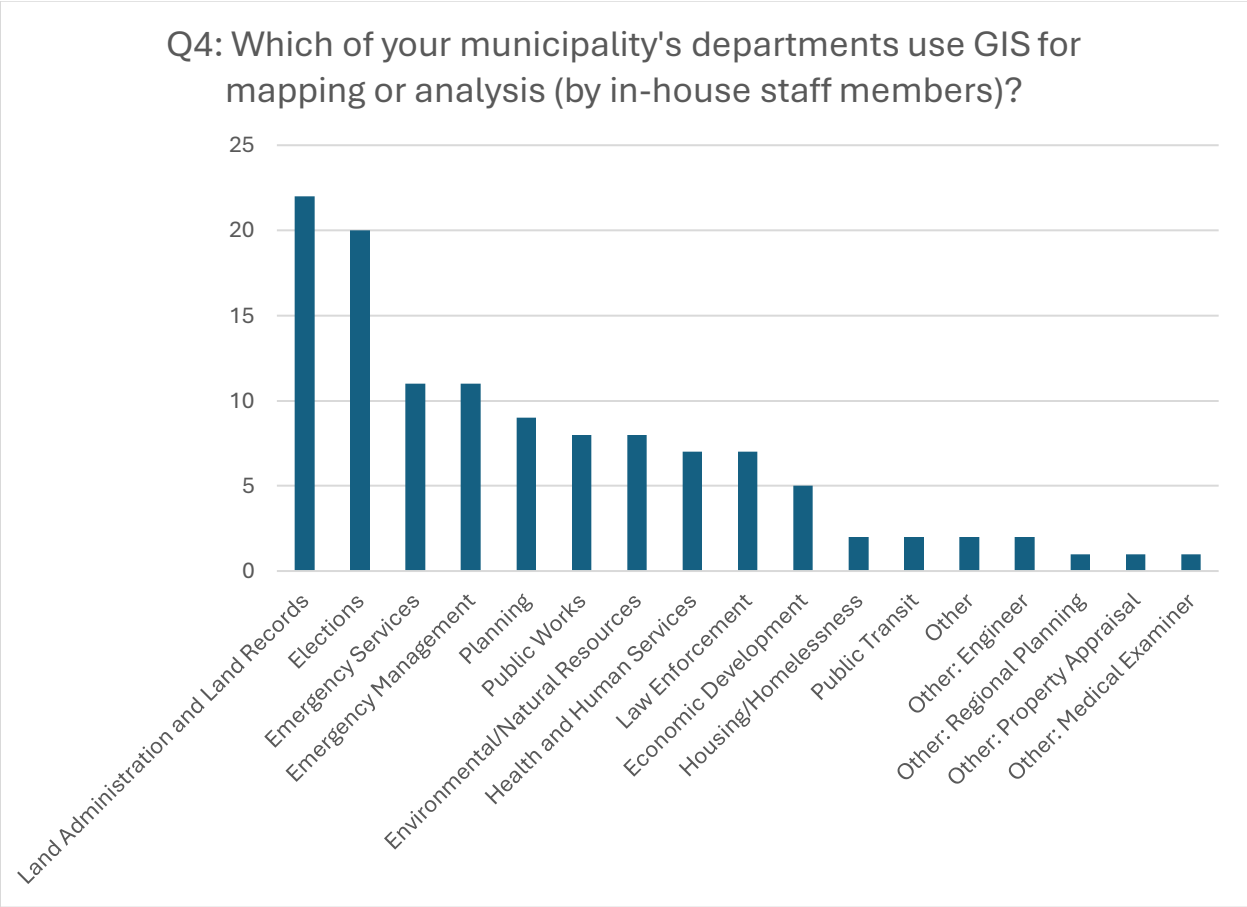

Figure 2: Departmental use of GIS in county governments

Most respondents reported they make as much spatial data available to residents online as possible. Three respondents indicated that they are limited to making certain departments data available and one respondent said their county does not make these data available to residents. Almost half of the respondents said there are no barriers to the data they share with residents and can make nearly all data available online. Some

respondents reported limitations to sharing data including availability and expertise of personnel, concerns about privacy or other legal issues, cost of adding and cleaning data, and technology limitations. One respondent indicated it is not a priority to share data online (Figure 3).

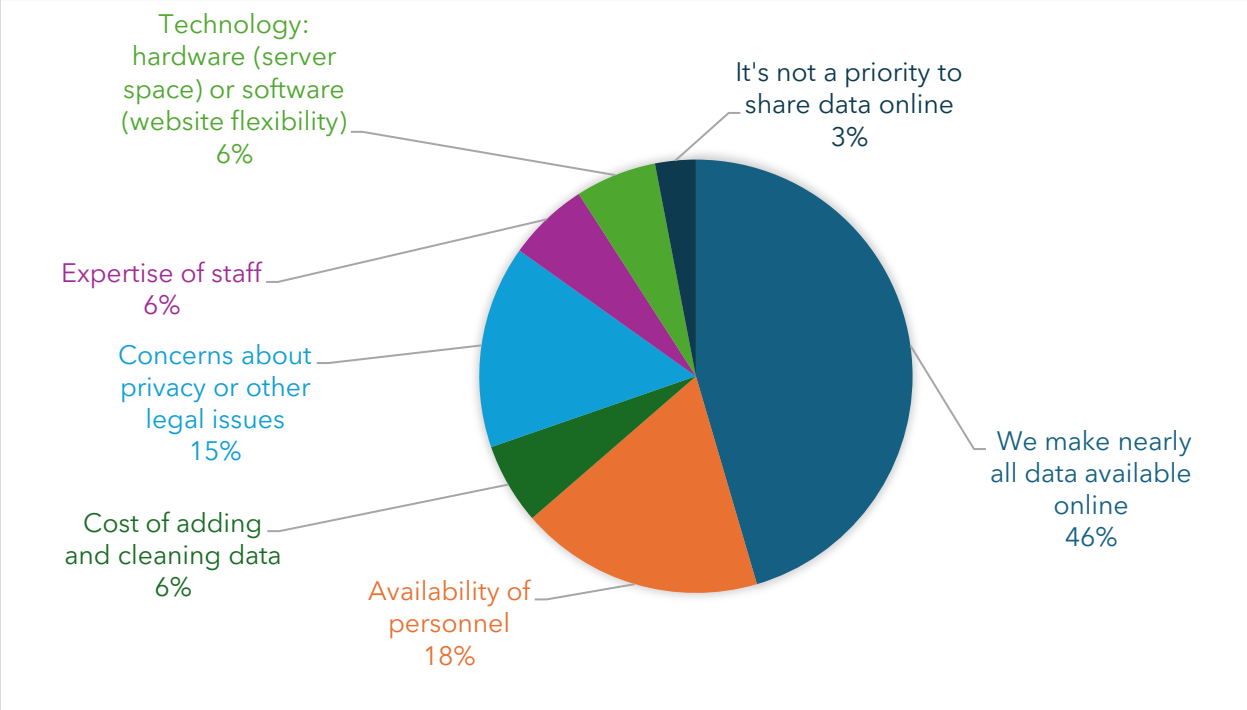

Figure 3: Responses to a question about data availability

Respondents were asked to identify areas where a university library and geography department could offer free help with mapping, spatial data, and spatial analysis. The most frequent responses included ArcGIS Pro training workshops, ArcGIS training (including Pro and Online/Enterprise), easy-to-use spatial data, and interns. Overwhelmingly, respondents reported the need for staff training (ArcGIS training, enterprise administration maintenance and database training, Python training and general staff training).

Interviews

The survey asked respondents if they would be willing to participate in a short interview to further discuss their county's GIS use. Eight individuals responded affirmatively and were interviewed. They were asked:

1. What are your county's GIS needs (departments needing maps, analysis, etc.)?
2. What is your current approach to meeting these needs, in terms of staff time, staff skills, hardware, and software?
3. Do you feel your county's GIS needs are always met with your current approach?

4. If not, what projects have you wanted/would you want more GIS support for? What type of support in terms of staff time, skills, hardware, or software?
5. Thinking ahead to the next five years, and cost was not an issue, what would you choose to invest in? (people, software, more contractors, etc.)
6. Assuming cost IS an issue, what could a free/non-profit mapping agency provide that would help? (training in open-source software, maps, analysis, etc.)

Though answers to question 1 varied by respondents, most respondents said the departments that need GIS most were engineering, emergency management, parcel maps, and tax maps for the auditor's offices. Other responses to this question included public facing maps, data management, and application development. All respondents reported access to ESRI products, most frequently using ArcPro. Most counties have 1-3 GIS professionals, the larger counties have 6-8 GIS personnel on their team. One respondent reported a transition from hiring a few GIS professionals who departments would sent work to, and instead training all county departments in GIS use. All respondents reported their county's GIS needs were being met, though most respondents said there is room for improvement.

If cost was not an issue, respondents would choose to invest in staff and technology. Some other hypothetical investments included additional cloud space, GPS tracking devices, data management and updating, connecting GIS departments state-wide, and increasing GIS literacy. Respondents often repeated their answers to question 5 when asked what a free or non-profit agency could provide. The largest non-repeat answer was access to interns that could provide labor for the counties in exchange for a learning experience. Respondents also mentioned a need for training in GIS, field collection, data management, and ArcGIS workshops for staff.

Website data audit

With nearly half of survey respondents indicating that they made all their GIS data available to the public, we were interested to see how this worked on county websites. The most common GIS use we found was a tax map with parcels, roads, and township boundaries for users to view, with the ability to click on parcels and learn information about the assessment and ownership. All but one of these maps was created using ESRI software. Some counties added layers with hydrologic data such as FEMA Floodplains, where homebuyers would be required to purchase flood insurance. Aerial photographs were also common, with a few counties providing maps dating back to the 1930s. A few counties also added layers for special districts, like school districts and fire districts, and others provided voting information like precincts and polling places. A few special topics stood out, such as counties that included a layer showing manufactured homes and others that showed rural drainage and petitions for improvement of ditches.

Data available for downloads was less common and showed a much broader range of topics. This is likely because the GIS viewer used by most counties was focused on

property taxes, open data is much more widely targeted. The most common data made available for download was parcel location (along with related data about property values). There was also a tendency to put all spatial data into the open data portal without explanation or editing. One example is a county that included the locations of drug overdoses from one month in 2017, data that was both random and potentially problematic in terms of individual privacy because it included home addresses. Another county included a link to its Survey123 app that allowed any user to add in traffic sign locations into their data file. On the opposite side of overly-open data, several sites required an ESRI login which could be restrict use by local residents and organizations without an ArcGIS subscription.

At the same time, there were some counties that clearly prioritized clear, useful, well-documented spatial data. Most of these counties used the new ArcGIS Data Hub to organize and share their data. Lake County, for example, highlights a link to parcel data, but also includes links to a population explorer map and a map of speed limits in the county. Counties with larger populations (and staff, and funds) often have a greater ability to gather, process, and share data. Franklin County (Columbus), for example, includes data such as building footprints and historic township boundaries,

Analysis

We found that while most counties had at least a few GIS professionals, many could use additional staff support. Many of those interviewed expressed an interest in interns with GIS skills, but often they did not have the funding to pay them. A desire for interns also suggests the need for additional staff time to do basic GIS tasks. On one hand, the prevalence of GIS software provides a lot of opportunities for sharing data with the public, but at the same time without staffing and/or training, the promise of these tools is unmet.

In terms of how staff time is spent and data viewing/sharing, the focus of most counties was on providing an online interactive map that allows the user to view and search maps showing property parcels. More than half of counties included contextual information like roads, hydrologic data (including FEMA flood zones in some cases), township and other district boundaries. The focus on providing outlines of boundaries, including and especially tax parcels was the strongest finding from our county survey.

While a few counties included mobile home locations, which suggest an interest in socio-economic conditions, very few counties provided location-specific census data that would allow for demographic or economic analysis. Environmental data (for viewing or download) was also uncommon, despite requirements by various governmental bodies for analyses like wetland delineation and lead water pipe mapping. So, the spatial data likely exists but was not available online. This suggests that more time and money is spent on collecting data (and using it internally) than sharing it online. While this is understandable given resource constraints, it is unfortunate given the opportunities presented by widely available spatial data.

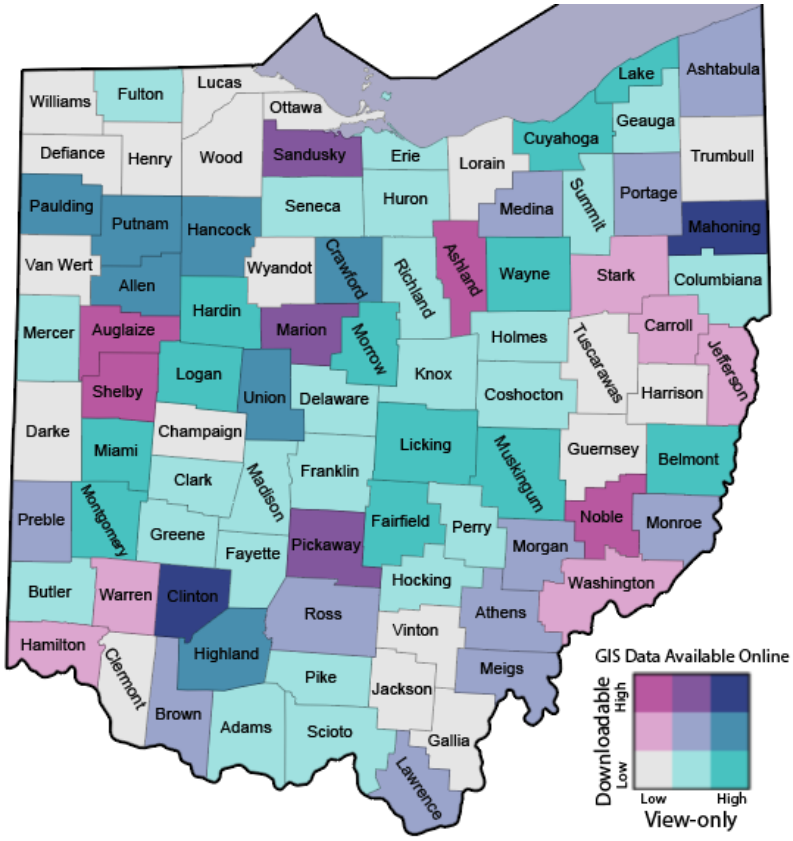

Figure 4: A survey of County GIS websites shows a wide variety of data availability.

Another finding of note is that while nearly half of the GIS professionals who responded to the survey said they "make nearly all data available online," we found a lack of data available for download (Figure 4). This suggests a difference in how we interpret "open data" -- despite the prevalence of ESRI software, only half of counties took advantage of their Data Hub tool to share data with the public, and of those, very little data was actually made available – in most cases due to it not being collected or analyzed by the county.

Conclusions

While many county governments in Ohio provide parcel map viewers (with a focus on ownership, zoning, and taxes), only a privileged few have the background and/or staff to use GIS to its full potential. For example, only seven percent of responding counties use GIS for economic development. Many counties continue to lag behind in their spatial

data acquisition and analysis, furthering the digital divide between the wealthiest and most populous counties and poorer, smaller counties in the state.

Adding an analysis of county websites helped us see a clearer picture of GIS data sharing by Ohio county governments. It suggests that the most valuable focus of our outreach work would be to create a clearinghouse of local spatial data, either on our own or working with local governments. In addition to allowing local governments to then better focus resources on economic/social/environmental analyses, the data could also then be used by local organizations and encourage local research.

Additionally, monthly or bi-monthly workshops in GIS is one way that Kent State or other universities could support local government. Staff may need a bootcamp to help get them up to speed on using ArcGIS Pro (its predecessor, ArcMap, is scheduled to be retired March 1, 2026). Specialists in non-GIS area may want an introduction to GIS and applications in their areas of expertise.

Overall, we found that while county-level GIS professionals are already a strong and nimble group, additional staffing and technology support could help them expand the use of spatial data and analysis internally. Our research also showed a need across the state for a better understanding of what is available and needed in terms of public spatial data.

References

Barkley, D. L. (1998) “Communities Left Behind: Can Nonviable Places Become Smart?” *Review of Regional Studies* 28(2): 1-17.

Cloud, J. (2005). The case of the missing overlays: A strategy for the history of the digital transition in cartography. In *Proceedings, AutoCarto 2005.* The 15th International Research Symposium on Computer-based Cartography.

Elwood, S. (2006). “Critical issues in participatory GIS: Deconstructions, reconstructions, and new research directions.” *Transactions in GIS*, 10(5), 693-708.

Li, R., K. Chen, and D. Wu. (2020). “Challenges and opportunities for coping with the smart divide in rural America.” *Annals of the American Association of Geographers* 110 (2):559–70. doi: 10.1080/24694452.2019.1694402

Mapes, J., D. Kaplan, K. Turner, C. Willer. (2017). “Building ‘College Town’: Economic redevelopment and the construction of community.” *Local Economy*. 32(7): 601-616.

Shannon, J., Hankins, K. B., Shelton, T., Bosse, A. J., Scott, D., Block, D., Fischer, H., Eaves, L., Jung, J., Robinson, J., Solis, P. Pearsall, H. Rees, A. and Nicolas, A. (2021). “Community Geography: Toward a disciplinary framework.” *Progress in Human Geography*, 45(5),1147-1168.

Neal, S. M., & Vettraino, J. T(2023) “The Where of Small-Town Governance: Charting the Path from Technocracy to Democracy.” In *Local Government Administration in Small Town America* (pp. 231-242). Routledge.

O'Looney, John. (2000). Beyond maps: GIS and decision making in local government. ESRI, Inc.

Robinson, J. A., Block, D., & Rees, A. (2017). “Community geography: Addressing barriers in public participation GIS.” *The Cartographic Journal,* 54(1), 5-13.