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Integrating Research and Extension to Improve Community Participation in Broadband Projects

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With the passage of the bipartisan Infrastructure Investment and Jobs Act in late 2021, billions of federal dollars for broadband infrastructure will be flowing into rural communities via states, whereas most federal broadband infrastructure aid had previously gone directly to internet service providers (ISPs). The idea is that states have greater insights into local conditions and broadband needs. However, due to well-documented gaps in broadband availability data and maps, as discussed by Whitacre and Biedny (2022), states are unable to easily evaluate strategies, policies, and programs. For example, broadband data are currently aggregated and not available at the household level; further, the data represent where ISPs *could* serve customers rather than where they actually do.

In this article, we share how participatory research methods—coupled with an integrated research and Extension approach—can enhance rural community participation in broadband expansion projects. We document how university research faculty, university Extension (county engagement and state specialists), a community development group, and a rural electric co-operative's broadband subsidiary are piloting a novel wireless broadband technology in Turney, a small town in rural northwest Missouri. Although our study is in progress, we share this example now as broadband spending ramps up and the timing is right to share how integrating research and Extension with local participation may enhance broadband expansion projects.

In the context of an evaluation, using a participatory approach helped the project team determine the best mode for data collection, design the experiment and survey methods, and enhance the project's policy relevance. Participant input ensured that researchers had local buy-in, communicated with community participants to increase response rates, and benefited from insights on appropriate comparison communities. We hope our example inspires additional collaborative projects that further leverage Extension field and campus faculty relations to combine participatory research and evaluation methods as decision makers look to improve broadband programs in rural areas of their state.

Using Participatory Methods to Improve Data Quality

Engaging local participants can conceivably improve the quality of data collected as part of a ground-up approach to broadband program evaluation. However, participation can also bias results by highlighting researchers' desired goals (Eckerd et al., 2021; Zizzo, 2010). Participatory evaluation builds on community-based participatory research principles as well as traditional evaluation techniques. It emphasizes improved communication and coordination with the local community and key stakeholders to improve experimental design, data collection, and data interpretation (via evaluation design). At a high level, stakeholders are groups with vested interest in a given project, such as community organizations (e.g., nonprofits) and community leaders (e.g., mayor, school superintendent, state representatives). See Box 1 for an explanation of community-based participatory research.

A participatory evaluation approach creates value for both academic researchers and community members (Cargo and Mercer, 2008; Vaughn and Jacquez, 2020). For academic researchers, there is value in identifying more relevant research questions, improving research quality, and collaborating with local community members to interpret survey and interview data within the local context and lived experience. Similarly, for community members, there is value in ensuring that research addresses relevant local issues, increases local ownership of a research project to provide a sense of pride and identity, and leverages increased publicity to pursue additional funding and resources. Extension faculty and staff help facilitate a relationship between the

Box 1.

Community-based participatory research is a framework for conducting research in partnership with those who will be directly affected by the research. Participatory research is an umbrella term for a wide range of research approaches that all share a common goal of treating participants as partners rather than as subjects. This type of research can also be described as action research, citizen science, or emancipatory research. The goal is to include participants at every point in the research process, from conceptualization to disseminating the results. The degree of participation will vary by project, depending on capacity and interest.

academic researchers and community members, ultimately improving outcomes for the state and residents.

Participatory Research and Its Nexus with Extension

Collaboration across the land grant university can have a bigger impact on a community than any individual research project or outreach effort alone. Extension can be vital to understanding which local groups should be consulted and included in a project. This may include local ISPs, community development coaches and community organizers, economic developers, healthcare leaders, and school districts (Bryson, 2004). Local champions—residents who participate in project planning and management to some degree—play a critical role in building connections and developing buy-in between the community and the research team. Local champions can ensure that a research team understands the local context and answer questions from residents in more casual, and therefore more comfortable, settings.

Participatory methods can blend a variety of engagement opportunities to ensure that many community voices are heard. This may include in-person interactions, such as participating in existing events (e.g., community festivals and standing organizational meetings), hosting special events in the community, and personal one-on-one conversations between project advocates and prospective participants. In addition, community members can be reached via a combination of mailings, phone calls, and door hangers—particularly where there is limited internet access. Online engagement may range from email lists to Facebook groups to discussion boards to Zoom meetings. Even communities with poor broadband access may have sufficient cellular access to participate in online discussions. All these methods can be enhanced by partnering with local organizations and media (e.g., newspaper, radio, roadside signage) for endorsements and advertising.

Implications for Research and Evaluation Design

Participation from those affected improves research and evaluation design. Local input ensures that researchers use an appropriate mode for data collection, communicate with community participants to increase response rates, and benefit from insight on appropriate comparison communities. Consulting local advocates also ensures the survey language makes sense to nonacademics and is positioned to build trust between researchers and participants.

Evaluations can vary in terms of what types of comparisons they make. For example, advance planning allows for comparison before and after a new broadband installation. If an installation is already in place, it is possible to compare communities with different levels of broadband access. However, it is important to ensure that other community characteristics are similar for this to be a valid comparison. It may be necessary to have multiple comparison communities to allow for averaging.

Participatory research methods can also be combined with other methods. In the case of research on broadband, installing connectivity equipment represents a clearly defined change in the status quo. Statistical techniques can exploit this change to better understand the impact with more accuracy than a pre/post comparison.[1]

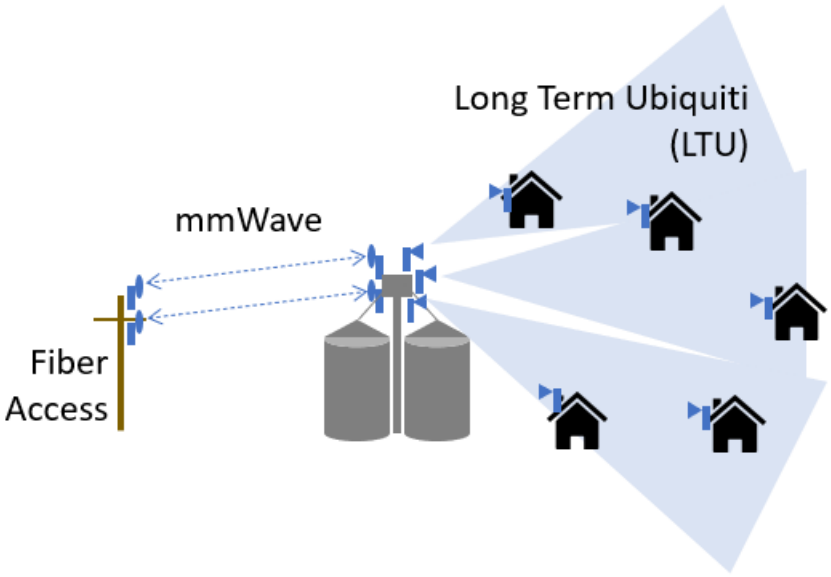
Wireless Broadband Pilot Project in Northwest Missouri

Over 14 million Americans, and almost a half million Missourians, did not have adequate access to high-speed internet in 2020, according to the most recent federal data (FCC, 2021a). The majority of the unserved live in rural areas, where availability (83%) is 10 percentage points lower than in metro areas. This connectivity gap is especially frustrating for rural communities close to urban centers (i.e., metro-adjacent), which lose daytime population, and their dollars, to commute outside the county for work.

To address this challenge, we deployed a wireless network in Turney, Missouri, to expand the fiber network owned and operated by United Fiber, a subsidiary of United Electric Cooperative. Further, we partnered with a local community development organization and University of Missouri Extension, whose deep local networks allowed us to use a participatory approach in

[1] For example, a statistical technique called difference-in-difference can be used to estimate the effect of broadband installation by measuring incremental improvement between the period prior to installation and the period after, assuming there have been changes over time anyway. For examples, see Rephann and Isserman, 1994, and Biedny, Whitacre and Gallardo, 2022.

Figure 1. High-Level Overview of Wireless Installation



our research project. Turney is representative of many small communities in the Midwest with respect to the presence of electric co-operatives as ISPs and Co-Operative Extension resources. Turney, located one hour northeast of Kansas City, has a population of 255, with 91 households, according to 2015–2019 American Community Survey data.

Our project team is cross-industry and cross-disciplinary, including academics (Missouri University of Science and Technology, Worcester Polytechnic Institute), Extension state specialists and county engagement specialists (University of Missouri), and community leaders (United Electric Cooperative/United Fiber and The Clinton County Initiative, supported by Maximize NWMO, the regional vitality initiative of the Community Foundation of Northwest Missouri). The local and regional community development groups are collaborations that include informal and formal leaders in education, health, economy, quality of life and government sectors as well as other interest areas. On-the-ground assistance from University of Missouri Extension and the grassroots infrastructure and engaged volunteer team aimed at inclusivity and shared interests that is supported by Maximize NWMO have been critical to this project. Broadband is a key priority for all of these groups, so we wanted to align our project with the largest number of participants possible in a sparsely populated area.

From a technical perspective, we are developing and testing an "intelligent router" to more dynamically allocate bandwidth between households to improve quality of service in a bandwidth-constrained environment. As shown in Figure 1, this includes a millimeter wave connection from the existing fiber network to the highest point in the center of Turney, a grain elevator. From this point, the network is distributed wirelessly using point-to-multi-point radios that use a proprietary protocol called Long Term Ubiquiti (LTU).

In addition to our project, Turney is partially served by a large ISP that is providing wired (non-fiber, VDSL) access as well as a preexisting fixed wireless provider.[2] Although the large ISP provides high-speed service (above 25 download/3 upload megabits per second [Mbps]), the preexisting fixed wireless provider service is not able to do the same (FCC, 2021b). Our wireless service provides speeds of approximately 200/50 Mbps, which exceed both existing providers and have a similar cost to consumers. As part of this project, we offered participants internet service free of charge from the time of installation (between October 2021 and February 2022) through April 2022 in exchange for participating in the evaluation of the project's effectiveness.

Our Participatory Efforts

In addition to the technical innovation, this project aimed to estimate the social impact of improved broadband access via survey and interview data. Following a community-based participatory research approach, we first began building relationships within the community to identify local champions. Although some of our team members are residents of the study county, none of the

[2] A subset of households in the study community were satisfied with their existing internet provider, the large ISP. Although this provider offered slower service, households were not motivated to switch providers unless they were highly dissatisfied. This is typical behavior, which makes it difficult for ISPs to predict adoption because highly dissatisfied is subjective and unquantified. There is inadequate data on existing providers, and service quality can quickly change if competitors upgrade equipment in anticipation of increased competition.

Table 1. Comparing Turney and the Comparison Communities

	Turney		Comparison Community Avg.	
Characteristic	**ACS**	**Survey**	**ACS**	**Survey**
Households (#)	91	54	482	36
Residents per household (avg. #)	2.80	2.96	1.94	2.67
Age 5-17 (%)	31	19	23	21
Bachelor's degree or higher (%)	10	39*	12	44*
White (%)	90	98*	93	94*
Households with wired internet access (%)	53	17	45	53

Notes: ACS data from the U.S. Census Bureau's American Community Survey, 2015-19.
*Survey respondent only, does not include the entire household.

original team members were residents of Turney. We targeted local organizations, such as the Turney Historical Society and churches, as well as government representatives, such as the mayor. We identified an Extension employee who is a Turney resident—co-author Debra Davis—as well as a Turney-based pastor to function as local champions.

In April 2021, we launched a community-facing website (https://www.maximizenwmo.org/broadband-project-overcome) to provide a central place for information about the project. In June 2021, we hosted an ice cream social at a Turney picnic shelter to announce the project, raise awareness, and provide opportunities for residents to ask questions. At this event, 19 households signed-up for additional information.

In September 2021, we hosted a kick-off event to announce that the primary network infrastructure was in place and we were ready to begin connecting households. Over 30 people attended this event, including a local state representative and school superintendent. At this point, 34 households expressed interest in participating in the network by completing our presurvey.[3] Because the town of Turney contains only 91 households, this was impressive turn-out—potentially driven by our participatory approach and trust-building in Turney. Unfortunately, only 12 of the households that expressed interest were within line of sight to connect to the network. To increase enrollment and leverage word-of-mouth awareness, we followed locals' advice to install a sign in the middle of town (November 2021) and use door hangers to target specific unenrolled households that met project criteria (January 2022).

Efforts to recruit households continued through February 2022. Ultimately, 29 households have been connected to the network. An additional 21 households expressed interest in participating but had inadequate line of sight due to terrain and tree coverage.[4] Most enrolled households are within one mile of the grain elevator. A few households have been able to connect at farther distances (up to three miles), particularly when near a major roadway that reduces tree coverage or when an additional pole could be installed to extend the wireless signal.

Measuring the Impact of the Connectivity Gap

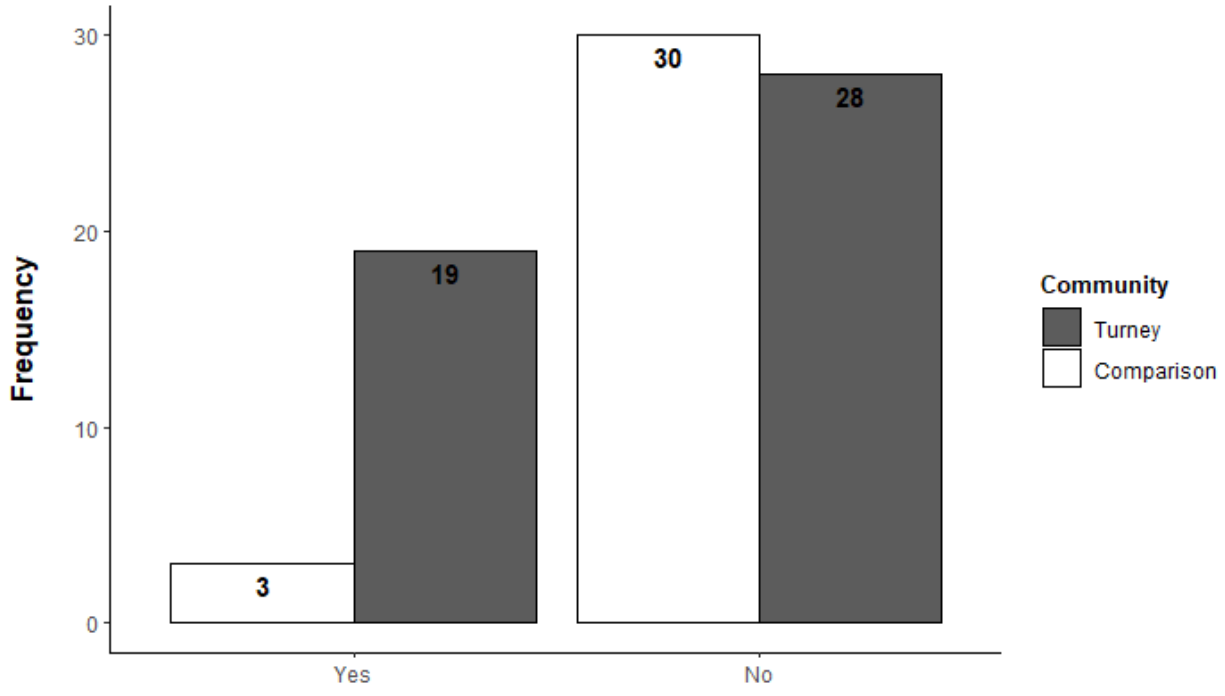
In the evaluation, the key outcomes of interest included use of the internet for employment (especially entrepreneurship and remote work), education, and healthcare. We selected 13 nearby communities as comparison communities, using 2015–2019 American Community Survey (ACS) demographic and broadband data. The comparison communities, on average, were similar to Turney (Table 1). The large margins of error in small-town ACS data led us to also use local input in selecting comparison communities, another instance in which the participatory approach was helpful. Data from the 2020 decennial census, which will be released later in 2022, will include improved estimates.

In August 2021, we launched the evaluation with a mailed presurvey. We mailed 200 surveys to households within a three-mile radius of the grain elevator in Turney as well as 700 surveys, to a random sample of households in 13 comparison communities. We had a 27% response rate (51 respondents) in Turney and a 5% response rate (36 respondents) in the comparison communities. The difference in response rates between Turney and our comparison communities was anticipated. It partially reflects the incentive for Turney participants (i.e., free high-speed internet) and partially reflects the impact of our participatory approach in

[3] Some households had previous negative experiences with fixed wireless service, which was typically unable to provide speeds exceeding 10/1 Mbps. This created some hesitancy to enroll in our study, which uses a much faster wireless technology.

[4] Software tools to estimate wireless propagation are often inaccurate, so signal measurements had to be taken at each household's location to evaluate whether they were a good candidate for connecting to the network.

Figure 2. Example of Survey Data Requiring Local Input for Interpretation



Turney. Ultimately, more than a third of Turney's 91 households are involved and more than half participated in our initial survey.

The participatory approach also supports efforts to interpret the survey results. For example, when asked, "In the last three months, have you used the internet for the following activities?" Turney residents reported higher demand for the internet for education tasks. Approximately, 37% of Turney residents reported using the internet for distance learning, while only 8% of residents in the control communities reported the same (Figure 2). Since Turney participants knew that they were completing this survey for improved internet access, they may have been incentivized to exaggerate demand or consider how they have used the internet over a longer period. In contrast, the comparison communities may be less motivated to remember or only focus on how they have recently used the internet, which may influence their responses.

Our local champions and larger community-based team identified additional explanations for the difference between the Turney and comparison community results. For example, Turney is located further from a public library than some comparison communities, making it more difficult to use the internet at a library. Second, Turney residents may be more likely to work in occupations better suited to remote work. Turney respondents had higher education levels, particularly in post-graduate education, than comparison community respondents, despite the two groups being similar in age. The interpretations gleaned from our community participants help prevent errors in interpreting the results of our research.

Lessons Learned

Our experience suggests that integrating research and Extension in broadband projects can make a bigger contribution to rural communities than either research or Extension can alone. We use our wireless broadband pilot project in Turney, Missouri, and efforts to measure its social impact as an example of a participatory project that depends on a team of academic researchers, Extension faculty, ISP partners, and community leaders. While this approach of inclusive involvement has not eliminated broader issues associated with data quality or bias in small communities, having strong local participation in the study community has made this project more robust. It has also raised awareness throughout the whole county and surrounding region of the need for more innovative and collaborative approaches to finding solutions to shared needs. Local newspapers have proactively covered the project and local and state elected officials have mentioned the project repeatedly in their public meetings and special interest community forums. Sample size is a major constraint for evaluations in small communities because researchers can only perform simple statistics (Coughlin and Smith, 2016; Riley and Fielding, 2001). Collaborating with local champions to identify strategies for increasing participation via various incentives and touchpoints has increased the quality of this research.

Broadband pilots and strong evaluations are critical for ensuring that government funds are being effectively deployed. It is likely that the determined effectiveness of the first portion of funds from the Infrastructure Investment and Jobs Act may affect eligibility for subsequent tranches. Participatory methods lend themselves to bottom-up evaluations of broadband solutions. When using participatory methods, however, one must carefully consider the incentives being created and how they may affect the research project. Our pilot benefited the community members who received free high-speed internet and research efforts were improved with community participation and on-the-ground feedback, but—as demonstrated—our results may be affected by the free high-speed internet incentive. We hope our study inspires additional participatory research and evaluation as policy makers strive to ensure access to high-speed broadband connectivity for all Americans and as rural communities consider wireless broadband technologies as a medium-term solution until fiber internet service is broadly available.

For More Information

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