Rural Broadband Task Force
Monday, May 17, 2021
Atrium, 1200 N Street, Lincoln, NE
Atrium Conference Center (Room 206)
3:00 p.m. CT to 4:30 p.m. CT

Links to agendas, minutes, and meeting materials are available at ruralbroadband.nebraska.gov

Agenda

3:00	**Opening Business**—*Ed Toner, Office of the Chief Information Officer* Roll Call Notice of Posting of Agenda Notice of Nebraska Open Meetings Act Posting ***Approval of the Feb. 7, 2020 minutes*** * ***Approval of the Sept. 11, 2020 minutes*** *
3:05	**Updates** • Legislation-Nebraska • Federal Broadband Updates • PSC Updates
3:30	**Broadband Technician Work Force—Report from the NUSF Subcommittee**
3:50	**Broadband and Agriculture** • Approval of Formation of Agriculture Subcommittee* • Draft Findings from the Agriculture Subcommittee
4:20	**Work Plan for 2021 Task Force Report to the Legislature and Governor**
4:25	**Membership**
4:30	**Adjourn**

* Denotes action items.
The task force will attempt to adhere to the sequence of the published agenda, but reserves the right to adjust the order and timing of items and may elect to take action on any of the items listed.

Meeting announcement was posted on the Nebraska Public Meeting and Rural Broadband Task Force website on March 26, 2021. The agenda was posted on the Rural Broadband Task Force website on May 10, 2021.
Nebraska Open Meetings Act

Directions: Room 206 is on the second level of the Atrium. Take the escalator or elevator to the second floor. Walk around the atrium until you get to the hallway with three blue Atrium flags. The Atrium Conference Center (Room 206) is down that hall.

Parking: A map of Lincoln parking garages is available at https://parkandgo.org/find-parking/ . The Center Park Garage is the closest parking garage.

Rural Broadband Task Force
Friday, February 7, 2020
1:30 p.m. to 3:00 CDT
1526 Building, 1526 K Street, Lower Level Training Room
Lincoln, Nebraska

Video Sites:
79225 Rye Valley Road, Callaway
Pinpoint Communications, 611 Patterson St., Cambridge
Homestead Bank, 619 Grand Street, St. Paul

MEMBERS PRESENT:
Ed Toner, Chair, Nebraska Information Technology Commission
Senator Bruce Bostelman, Nebraska Legislature
Mary Ridder, Chair, Nebraska Public Service Commission (Video conferencing)
Steve Wellman, Nebraska Department of Agriculture
Zachary Hunnicutt, Farmer, Hunnicutt Farms
Isaiah Graham, Vice-President, Homestead Bank (Video conferencing)
Daniel Spray, Owner, Precision Technology
Timothy Lindahl, CEO/General Manager, Wheat Belt Public Power District
Ron Cone, Director of Network Information Services, ESU 10
Tom Shoemaker, President, Pinpoint Communications (Video conferencing)

MEMBERS ABSENT: Senator Curt Friesen, Nebraska Legislature; Anne Turman, Catholic Health Initiative; Tony Goins, Nebraska Department of Economic Development; Andrew Buker, University of Nebraska

OPENING BUSINESS, ROLL CALL NOTICE OF POSTING OF AGENDA NOTICE OF NEBRASKA OPEN MEETINGS ACT POSTING
Ed Toner, Office of the Chief Information Officer

Mr. Toner called the meeting to order at 1:40 p.m. There were nine voting members present at the time of roll call. A quorum existed to conduct official business. The meeting announcement was posted on the Nebraska Public Meeting and Rural Broadband Task Force Websites on Jan.15, 2020. The agenda was posted on the Rural Broadband Task Force website on Jan. 27, 2020.

APPROVAL OF THE OCTOBER 18, 2019 MINUTES

Mr. Cone moved to approve the October 18, 2019 meeting minutes as presented. Mr. Spray seconded. Roll call vote: Toner-Yes, Ridder-Yes, Wellman-Yes, Hunnicutt-Yes, Graham-Yes, Shoemaker-Yes, Spray-Yes, Lindahl-Yes, and Cone-Yes. Results: Yes-9, No-0, Abstained-0. Motion carried.

INTRODUCED BILLS AND UPDATES

Overview of Introduced Bills
The meeting began with an overview of introduced bills from Tip O'Neill. The Transportation and Telecommunications Committee held a hearing on LB 898, LB 992, and LB 995 on Monday, Feb. 3, 2020.

LB 898 Provide for the collocation of certain wireless facilities. This bill was introduced by Senator Friesen and received comments both in support and in opposition.

LB 996 Create the Broadband Data Improvement Program. This bill was introduced by Senator Brandt and authorizes the Nebraska Public Service Commission to establish a program to verify data on broadband availability. It will likely be Senator Brandt's priority bill.

LB 992 Adopt the Broadband Internet Service Infrastructure Act and provide for certain broadband and Internet-related services. LB 992 was introduced by Senator Friesen and would implement several recommendations of the Rural Broadband Task Force. It has been designated as one of the Transportation and Telecommunications Committee's priority bills. The Broadband Internet Service Infrastructure Act included in LB 992 would establish a process for using electric easements for telecommunications. It is based on legislation enacted by Colorado. The Transportation and Telecommunications Committee has asked the Attorney General for an opinion. The bill would also establish a state broadband coordinator, modify the restrictions on leasing dark fiber by public entities, establish four positions within the Nebraska Library Commission to provide E-Rate and technical assistance to libraries, and would establish an E-Rate Special Construction Matching Program.

Public-Private Partnerships

Mr. Toner provided an opportunity for task force members to comment on introduced legislation.

LB 992 Adopt the Broadband Internet Service Infrastructure Act and provide for certain broadband and Internet-related services

Broadband Internet Service Infrastructure Act--Sections 1 to 5. There were no comments from task force members.

State Broadband Coordinator--Section 6. Zachary Hunnicutt said that several states have placed broadband offices or coordinators within the Department of Economic Development. Mr. Toner said that whether the position is housed in the OCIO or the Department of Economic Development, the two entities must work collaboratively together. Tony Goins, the new director of the Nebraska Department of Economic Development, Ed Toner, and the Governor's Office have begun discussions on collaborating on broadband activities. Tim Lindahl asked if there was a job description in place yet. LB 992 lays out the following general responsibilities:

a) Encourage each county or region comprising a group of counties to appoint a broadband coordinator to facilitate broadband planning and coordination;

b) Encourage each county or region to work with groups of stakeholders, which may include, but not be limited to, businesses and industries, community foundations, local governments, local or regional economic development organizations, schools, colleges, other educational entities, public libraries, health care institutions, financial institutions, telecommunications providers, public power districts, electric cooperatives, nonprofit organizations, and other interested entities;

c) Assist such counties, regions, and stakeholders in determining what broadband assets are available, the areas for improvement, and strategies to improve broadband availability and use; and

d) Explore the creation of broadband cooperatives in unserved or18 underserved areas of the state.

Leasing Dark Fiber and Terminating Nebraska Internet Enhancement Fund—Sections 9-12. There were no comments from task force members.

Rural Broadband Task Force Term Limits—Section 13 (page 16, line 30 to page 19, line 17). There were no comments from task force members.

LB 898 Provide for the collocation of certain wireless facilities. There were no comments from task force members.

Digital Inclusion, Homework Gap, and Leveraging Funding

Updates—NUSF 117. Cullen Robbins said that the Nebraska Public Service Commission opened Docket NUSF 177 on December 10 asking if the Commission had the authority to establish an E-Rate Special Construction Matching Fund. One party questioned if the Commission had the authority. LB 992 would give the Commission express authority to establish the matching fund. Ron Cone asked if the schools would be eligible to participate in the matching program. Mr. Robbins said that the docket does not exclude schools. He encouraged schools to participate in the record.

Updates—Nebraska Library Commission. Rod Wagner gave an update on the Nebraska Library Commission's activities to increase library participation in the E-Rate program and to improve library broadband. The Commission redefined an internal job description to hire a staff employee to focus on E-Rate Category 2 related tasks.

Regional Technicians, Nebraska Library Commission--Section 7. Task force members discussed the fiscal impact of adding four regional library technicians and asked if other options—including contracting for support or including installation costs in the bids—were considered.

NUSF and Reverse Auction

The Public Service Commission has released the third draft of the proposed rules for a reverse auction. A hearing has been set for March 24. An additional docket is open to examine allocations to price cap carriers.

Rural Digital Opportunity Fund. FCC adopted the order or establishing the Rural Digital Opportunity Fund on Jan. 30, 2020. The final version was made available on Feb. 7, 2020. billion dollars. $16 billion has been allocated for phase I which will target areas identified as unserved using the FCC's current mapping program. A challenge process will be used to identify areas which were identified as unserved but actually are served. The process will be similar to the process used for the Connect America Fund II reverse auction. Once the auction gets below the budget, awards will be made to bidders offering the best service. Weights will be assigned to favor more robust technologies. Bidding will start on Oct. 22, 2020.

The FCC has allocated $4.4 billion for Phase II which would include the unserved areas in census blocks that are partially served and unserved areas which were not included in phase I but were identified through a new mapping process.

Broadband Data and Mapping

Update: Federal Broadband Data Act, Cullen Robbins. Both the House of Representatives and the Senate have approved versions of the Broadband Data Act. The bill may be enacted this spring. The legislation is similar in many respects to the FCC's new broadband mapping program, but also includes a few differences. The Broadband Data Act would include improvement in broadband mapping for mobile wireless carriers. It would also include a validation process. Data would need to be update every six months. It would require the FFC to develop a user friendly challenge process.

L**B 996 Create the Broadband Data Improvement Program.** This bill would authorize the Public Service Commission to create a program to verify broadband availability via crowdsourcing. The PSC was unable to determine any cost estimates associated with LB 996 because the FCC has not yet developed any guidance for states.

ADJOURNMENT

The next Rural Broadband Task Force meeting will be scheduled in April or May.

Mr. Wellman moved to adjourn. Mr. Honeycutt seconded. All were in favor. Motion carried. The meeting was adjourned at 2:56 p.m.

Meeting minutes were taken by Lori Lopez Urdiales and reviewed by Anne Byers of the Office of the CIO.

RURAL BROADBAND TASK FORCE
Friday, Sept. 11, 2020 9:30 a.m. to 12:00 noon CT
1526 Building, 1526 K Street, Lower Level Training Room, Lincoln, Nebraska

MEMBERS PRESENT:
Ed Toner, Chair, Nebraska Information Technology Commission
Senator Curt Friesen, Nebraska Legislature
Senator Bruce Bostelman, Nebraska Legislature
Dan Curran for Tony Goins, Nebraska Department of Economic Development
Zachary Hunnicutt, Farmer, Hunnicutt Farms
Timothy Lindahl, Wheat Belt Public Power District
Andrew Buker, University of Nebraska

Members Participating via Video (Participation only, not able to vote)
Mary Ridder, Nebraska Public Service Commission
Isaiah Graham, Homestead Bank
Tom Shoemaker, Pinpoint Communications
Ron Cone, ESU 10

MEMBERS ABSENT Steve Wellman, Nebraska Department of Agriculture; Anna Turman, Catholic
Health Initiative; Daniel Spray, Precision Technology

OPENING BUSINESS, ROLL CALL NOTICE OF POSTING OF AGENDA NOTICE OF NEBRASKA OPEN MEETINGS ACT POSTING
Ed Toner, Office of the Chief Information Officer

Mr. Toner called the meeting to order at 9:35 a.m. There were seven voting members present at the time of roll call. A quorum was not present to conduct official business. The meeting announcement was posted on the Nebraska Public Meeting and Rural Broadband Task Force websites on August 13, 2020. The agenda was posted on the Rural Broadband Task Force website on August 19, 2020.

APPROVAL OF THE FEB. 7, 2020 MINUTES*

Approval of the minutes was tabled.

UPDATES

Legislation-Nebraska
Senator Friesen gave the legislative update. LB 992 was amended due to the financial challenges facing the state as a result of the COVID-19 pandemic. The amendment took out the library positions and moved the effective date of the broadband coordinator position to July 1, 2022. The amendment also moved the broadband coordinator to the OCIO. The bill specifies a process to use electric utility easements for communications, establishes an E-Rate matching program, defines the length of terms for task force members, and made changes to process of leasing dark fiber by public entities. The bill was passed by the legislature and signed by Governor Ricketts.

LB 996 creates the Broadband Data Improvement Program. It was also passed by the legislature and signed by Governor Ricketts.

Hearings may be held on two interim studies:
- LR 438 Interim study to continue to monitor the activities of the Rural Broadband Task Force that was created by Laws 2018

- LR 429 Interim study to examine issues related to mapping broadband coverage throughout Nebraska, hopefully federal program will help state's efforts.

Mr. Toner thanked Senators Friesen and Bostelman for their efforts to advance rural broadband.

Nebraska Department of Economic Development. On June 12, 2020, Governor Ricketts announced that $40 million in CARES Act funding would be used for a Nebraska Broadband Grant Program. The program is being administered by the Nebraska Department of Economic Development. Mr. Curran explained that guidance from the Department of Treasury stated that projects had to be completed by Dec. 30, 2020. The tight timeline presented a challenge. Over 100 applications were submitted. Sixty-one grants totaling approximately $29.5 million were approved. A list of awardees will be made available after all of the contracts are finalized. Many of the projects are underway. A handful of projects are 60% complete. Senator Bostelman asked if the projects funded were in rural areas outside of towns or in towns. Many of the projects are for areas outside of city limits.

Nebraska Public Service Commission. Cullen Robbins provided updates on Commission actions:
- The Nebraska Public Service Commission issued an order adopting rules for a reverse auction on July 14, 2020 through their Rules and Regulations 202 docket**.**

- The Nebraska Public Service Commission is examining changes to the provision of high cost support to price cap carriers including updating the minimum speeds and implementing a time limit in which to complete projects through the NUSF 99 docket.

- The PSC has opened a docket seeking comment on modernizing the contribution system for business and government services.

- The Nebraska Public Service Commission approved the Nebraska Special Construction Matching Fund program and allocated $1 million over four years for the program.

- The PSC has also been working on a docket focusing on telehealth.

- The PSC established a $1 million grant program to provide broadband services at no cost to low-income consumers impacted by the COVID-19 pandemic. The Commission has started receiving applications from carriers.

PUBLIC-PRIVATE PARTNERSHIPS AND PRECISION AG
Panelists: Julie Bushell, Paige Wireless; Pat Pope, NPPD; Tim Lindahl, Wheat Belt Public Power District; and Zachary Hunnicutt, Hunnicutt Farms

Julie Bushell said that Paige Wireless will cover the state with LoRaWAN. LoRaWAN stands for Long Range Wide Area Network and is a low power networking protocol designed to connect battery-operated sensors and other devices to the internet. LoRaWAN can provide connectivity for sensors at approximately one-tenth of the cost of a cellular connection. Dropping the price of connectivity can lead to a revolution in data. It is being used for ground water modeling by the Twin Platte NRD. It can also be used for agricultural applications. A pilot in Arnold is providing 130 Mbps down/130 Mbps up broadband to the combine. Ms. Bushell invited task force members to visit the precision ag pilot site in Arnold. Ms. Bushell also said that she co-founded a cooperative of wireless internet service providers to leverage their resources.

Pat Pope discussed how NPPD has been partnering with Paige Wireless and other efforts to promote the deployment of broadband in Nebraska. NPPD had looked at partnering with telecommunications to apply for funding from the Rural Digital Opportunity Fund, but found there wasn't enough time to get everything in place to submit an application to bid. NPPD's experience pointed out the need to be prepared with shovel-ready projects. NPPD is focusing on planning and is working with NRTC to promote service territory-wide. OPPD, Loup Power District, and South Central Public Power District are also involved in the planning effort. NPPD has also sponsored the University of Nebraska at Kearney broadband speed test project.

Tim Lindahl said that he has been talking to Isfandiyar Shaheen from Netequity about a pilot project to install aerial fiber using technology developed by Facebook. The technology can only be used for open networks.

Julie Bushell is Vice Chair of the Encouraging Adoption of Precision Agriculture and Availability of High-Quality Jobs on Connected Farms Working Group. Dan Spray is also a member of that working group. Zach Hunnicutt and Public Service Commissioner Dan Watermeier are members of the Accelerating Broadband Deployment on Unserved Agricultural Lands Working Group. Ms. Bushell and Mr. Hunnicutt gave brief updates on the working groups.

Task Force members were interested in forming a subcommittee on agriculture. Discussion of the formation of a subcommittee was tabled until the next meeting.

BROADBAND AND TELEHEALTH IN RURAL NEBRASKA
Panelists: Brian Sterud and Grant Nordby, Faith Regional Health Services; Leslie Marsh, Lexington Regional Health Center

Grant Norby shared three ways Faith Regional Health Services is using telehealth:

- **Asynchronous virtual visit from a cell phone**. If needed, the visit can be stepped up to a chat or phone call.

- **Video visits through the teleclinic network.** These were used for visits with nursing home patients.

- **Directed visits.** Patients were sent a link and could be seen by a doctor.

Most clinics had adequate broadband. Tilden struggled with connectivity issues.

Through a telehealth grant from the FCC, Faith Regional is implementing a remote patient monitoring program. Over 100 devices were purchased. The project will prioritize COVID-19 patients or those at risk of complications. Patients will need WiFi or cellular service.

Leslie Marsh shared that Lexington Regional Health Center has been using telehealth for specialist services including telepsych and telestroke. After the COVID-19 uptake, waivers by the Centers for Medicare & Medicaid Services (CMS) allowed more uses of telehealth. Lexington Regional Health Center used telehealth to treat patients in the hospital so only a nurse was in the room. This helped keep staff safe and conserved personal protective equipment. Lexington Regional Health Center also started a virtual respiratory clinic. They also started using Zoom for patient visits, but found that patients had to have time to download the app. They switched to Facetime which was easier for patients. Lexington Regional Health also used Facetime on iPads in rooms to bring in translators for patients who did not speak English.

Panelists mentioned several benefits to telehealth:
- Keeping patients and staff safe while still providing care
- Managing client care including wellness visits
- Managing language and culture
- Lowering barriers to care—An asynchronous telehealth visit is $40 with or without insurance.
- Improving access to services—especially telepsych

HOMEWORK GAP & CARES ACT FUNDING FOR EDUCATION

Panelists: *Dean Folkers, Nebraska Department of Education; Ron Cone, ESU 10; Andrew Buker, University of Nebraska; Michael Oltrogge, Nebraska Indian Community College*

Tom Rolfes moderated the session.

Dean Folkers shared information on how CARES Act funding is being used to address student devices and connectivity. The CARES ACT includes the following funding programs:
- Local Education Agency Resources ($59 million)
- Statewide ($6.5 million)
- Governor's Emergency Education Relief Fund (GEER) ($16.4 million). Priorities include addressing the digital divide and related issues to support remote learning for students in K-12 schools and providing equitable access to technology for all students and improving parity in access to all schools. Funds can be used for hardware purchases for use of school students and improving access to reliable, high-speed internet for students. Some flexibility will be reserved to address additional COVID-19 issues.

The Nebraska Department of Education estimates that approximately 40,000 students do not have sufficient educational broadband access at home. Project options include:
- Mobile Cellular Hotspots
- Homework Hotspots at Community Institutions
- Working with Local Internet Providers
- TV White Space (TVWS) [470-698 MHz]
- Wireless Education Broadband Services (EBS) [2.5 Ghz]
- Low Earth Orbit (LEO) Satellite Service

Information on student devices and connectivity is being collected by a survey. A Request for Quote (RFQ) has been issued to internet service providers.

Ron Cone shared information on how schools in ESU 10 are addressing the homework gap. Grand Island Public Schools identified over 120 student homes that lacked internet service due mainly to affordability issues. Grand Island Public Schools purchased 120 mobile hot spots. They are concerned about ongoing monthly costs and tracking hotspots. Grand Island Public Schools is looking at a CBRS wireless solution which will provide 5 Mbps down/5 Mbps up per student or 10 Mbps down/10 Mbps up per home.

Central Valley Public Schools (Greeley, Wolbach, North Loup & Scotia) identified 56 homes and 118 individuals (students and teachers) with inadequate or no internet access. During the COVID-19 closure, the district relied heavily on printed instructional packets. These households are located across a large geographic area. The district has engaged local providers for possible solutions and available service options at the bandwidth needed. The district is also researching a wireless solution using TVWS or 900MHz. Multiple tower locations and heights would be needed. The district may contacting the local coop and tower owners or consider constructing their own tower.

Dr. Oltrogge shared information on the Northeast Nebraska Tribal Broadband Wireless Project. The educational broadband wireless project is set up so that all K-12 and NICC students within the boundaries of the Omaha and Santee Reservations gain access and maintain access to the internet for remote and other learning opportunities. The project is using the 2.5 GHz Rural Tribal Broadband spectrum. The Santee Reservation and Omaha Nation submitted applications in July. The Santee Reservation application is straight forward. The Omaha Nation application requested a waiver to include the entirety of the Bancroft-Rosalie School district with the support of the Omaha Nation, the Bancroft-Rosalie's schools and the Village of Bancroft. The Santee Reservation and Omaha Nation received Special Temporary Authorizations (STA's) from the FCC to turn the systems on when operational. The STA's are valid until December 15-20, 2020. The Nebraska Indian Community College, via the Omaha and Santee Nations, will maintain the FCC license.

The college paid for the base stations and the majority of the base station installation costs via CARES Act funds. The college will be paying for the end user equipment and installation costs for its students. The college will have overall control of the cloud core.

Umo^{n}ho^n Nation, Bancroft Rosalie, Walthill, Pender and Santee are the base station locations and will maintain internet connectivity. The students at each of the schools have the capability to utilize no cost internet services. The schools provide the installation and their end user equipment for their students. All parties will be signing an official MOU in the future.

Andrew Buker shared information on the Eduroam project. Eduroam is a secure, world-wide wireless network roaming access service developed for the research and education community. It allows students, faculty, and staff from participating institutions to obtain secure Internet connectivity across participating institutions by simply opening their laptop or turning on their device. Eduroam is available in over 100 countries and more than 12,000 locations, from campuses to coffee shops. Eduroam is based on the most secure wireless encryption and authentication standards in existence today, far exceeding typical commercial hotspots.

Network Nebraska will join an Internet2 program to allow all members to offer Eduroam services. NDE has secured $65,000 in CARES funding to cover first year costs. Participating school districts will remain in control of their own policies and content filtering for compliance with CIPA, COPPA, and USAC E-Rate funding. Students, faculty, and staff will have access to Eduroam hotspots throughout the state.

ADJOURNMENT
Mr. Hunnicutt moved to adjourn. Mr. Buker seconded. The meeting was adjourned at 12:10 p.m.

Meeting minutes were taken by Lori Lopez Urdiales and reviewed by Anne Byers of the Office of the CIO.

Rural Broadband Task Force
Agriculture Subcommittee
Draft Initial Findings
April 22, 2021

Executive Summary

Agriculture is a significant part of Nebraska's economy. The market value of crops and livestock produced in Nebraska in 2017 was $21,983,430,000 with a per farm average of $474,476.[1]

Fully adopting next generation precision agriculture technologies in the United States would result in potential annual gross benefits of up to $13 billion for row crops and $20.6 billion for livestock and dairy with over a third of these benefits dependent on broadband.[2]

Farmers and ranchers need upload speeds of at least 30 Mbps to transfer the immense amount of data generated to the cloud. In the future even greater upload speeds may be required.

Rural areas of most Nebraska counties—including many of Nebraska's top-producing agricultural counties—lack broadband with upload speeds of greater than 25 Mbps or fiber connectivity. The table below shows broadband availability for the rural areas of Nebraska's top-producing agricultural counties.

% Rural Population with Broadband available (ADSL, Fiber, Cable, Fixed Wireless) Dec 2019 Top 10 Nebraska Counties by Agricultural Sales (2017)					
County	Agricultural Sales	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Cuming County	1,131,997,000	83.83	74.63	74.1	7.06
Custer County	781,155,000	53.02	7.21	0.13	3.25
Lincoln County	755,236,000	81.47	51.37	36.7	35.52
Dawson County	748,426,000	63.95	38.21	33.59	7.11
Platte County	688,562,000	95.06	72.08	56.61	1.26
Phelps County	578,241,000	85.9	62.42	60.18	37.16
Antelope County	529,502,000	80.12	44.25	8.46	17.45
Boone County	473,778,000	63.08	53.74	0	0
Holt County	453,539,000	75.41	16.31	0	16.31
Chase County	440,113,000	100	93.83	12.36	12.36

Source: USDA 2017 Census of Agriculture County Profiles data available at
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/
Dec 2019 FCC Form 477 data from the FCC Broadband Map at https://broadbandmap.fcc.gov

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[1] USDA NASS. 2017 Census of Agriculture State Profile. Available at
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/cp99031.pdf
[2] USDA. A Case for Rural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision Ag Technologies. (April 2019). Available at https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

Different methods of connectivity are required for agriculture, including:

- Low-bandwidth connectivity for devices like sensors or monitors often called internet of things (IoT) devices
- High speed, centralized broadband with upload speeds of at least 30 Mbps up for targeted agricultural operational headquarters such as a farm or ranch operations center
- High-speed decentralized coverage over large agricultural areas

The following connectivity profile provides additional details about types of internet connectivity needed.

Connectivity Profiles for Next Generation Precision Agriculture

	Low-Speed, Broad Coverage	High-Speed, Centralized	High-Speed, De-centralized
Geographic Coverage	Large areas (i.e., agricultural fields)	Targeted agricultural operational headquarters such as farm or ranch operations center, typically one site per producer.	Large areas (i.e., agricultural fields)
Network Speed	Slow (< 5 mb/sec)	Broadband and faster (25 mb/sec) +	Broadband and faster
Network Latency	High latency is tolerable	Low latency	Low latency
Upload/Download Speeds	Asymmetrical (faster download, slower upload) Expect small upload and downloads over time from many sensors and field devices	Symmetrical (same download and upload speeds) Expect large upload and downloads to support processing of large data files, and online training and support	Symmetrical Expect large uploads to transmit live video for remote monitoring and real-time decision making
Usage	• Transmit sensor data from fields • System automation and monitoring • Mobile access to systems and data for workers and decision makers	• Farm-level data aggregation and modeling • Raw data uploads for processing (drone and other sensor data) • Remote training and systems support • Online cattle auctions	• Field-level video streaming • Large uploads of HD videos and photos • Live video conferencing for support

Adapted from Examining Current and Future Connectivity Demand for Precision Agriculture Report Oct. 2020 by the Connectivity Working Group of the FCC's Precision Agriculture Committee pages 8-9
https://www.fcc.gov/sites/default/files/precision-ag-connectivity-demand-wg-report-10282020.pdf

Other Issues

Legal and technical issues—including data ownership and portability, right to repair, and technical standards and interoperability—may impede the full adoption of next generation precision agriculture technologies. Industry efforts to address these issues would likely accelerate the adoption of precision agriculture technologies.

Research and outreach efforts on best practices in connected agriculture technologies and the associated return on investment could accelerate adoption. Because farming varies from state to state and within regions of a state, research and outreach efforts should be localized and feature farmers and ranchers who are early adopters of next generation precision agriculture technologies

Terms and Definitions

Precision and Connected Agriculture Technologies

Auto-guidance enabled farm equipment and variable rate technologies were among the first generation of precision agriculture technologies.

Auto-Guidance Enabled Farm Equipment has a global navigation satellite system (GNSS) receiver which processes satellite signals to determine position. The use of a differential correction system using satellite, Real Time Kinemetics (RTK) radio or mobile (cellular) networks improves the accuracy of the estimated geographic coordinates in real time. John Deere's RTK network offers horizontal pass-to-pass accuracy of +/-2.5 cm.

Auto guidance systems on farm equipment such as tractors, combines, harvesters, planters, seeders, and sprayers and applicators have many benefits, including reduced skips and overlaps, the ability to work in poor visibility conditions, the ability to skip certain areas and return later, and event logging.

Newer farm equipment and on-board monitors may also be able to connect to the internet via LTE or WiFi. This allows for the delivering of prescriptions for product applications and other uses. The United Soybean Board survey found that 29% of farmers and ranchers access the internet with their machinery.

Variable-rate technology (VRT) enables producers to precisely control the rate of application of crop inputs and tillage operations.

Next generation precision agriculture technologies include internet-connected sensors, monitors, and controllers as well as decision support systems using artificial intelligence tools. The term **connected agriculture technologies** refers to equipment and devices which are connected to the internet and programs or services which are accessed through the internet.

Internet connected devices such as soil moisture sensors, temperature sensors, flow meters on a pivot, and ear tags which monitor animal health are providing farmers and ranchers with real-time information on their crops and livestock so that they can make better decisions. The use of monitors/sensors in agriculture is still in the early adoption phase with only about 10-15% of agricultural producers widely using these technologies. [3]

Decision support systems using artificial intelligence (AI) technologies can help farmers and ranchers make better decisions in managing their crops and livestock.

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[3] Presentation by Roric Paulman on October 15, 2020 as part of a precision ag demo.

Draft Findings

Agriculture in Nebraska

Agriculture is a significant part of Nebraska's economy. The market value of crops and livestock produced in Nebraska in 2017 was nearly $22 billion ($21,983,430,000) with a $9.3 billion from crops and $12.7 billion from livestock, poultry and products. Cattle and calves brought in $10.6 billion which was 48% of total agricultural sales and 84% of sales of livestock, poultry and products in Nebraska. Of the 22,242,599 acres of cropland in Nebraska, 43% (9,455,031 acres) is planted with corn for grain and 25% (5,664,225 acres is planted with soybeans. The average market value of products sold per farm was $474,476.[4]

Economic Impact of Next Generation Precision Agriculture Technologies

Fully adopting next generation precision agriculture technologies would result in potential annual gross benefits of up to $13 billion for row crops and $20.6 billion for livestock and dairy with over a third of these benefits dependent on broadband.[5]

The tables below provide a breakdown of potential annual gross benefits for row crops as well as livestock and dairy by technology.

Row Crops			
Technology	**Potential Annual Gross Benefit**	**Potential Attributable to Broadband**	**% Dependent on Broadband**
Microclimate Modeling Technology	1,574,000,000	787,200,000	50%
Yield Monitoring Technology	1,771,000,000	177,100,000	10%
Precision Seeding	810,000,000	162,000,000	20%
Field Scouting	1,423,000,000	711,300,000	50%
Variable Rate Application	1,715,000,000	171,500,000	10%
Connected Equipment	638,000.00	191,300,000	30%
Machine Learning and Visioning	905,000,000	452,500,000	50%
Remote Diagnostics & Predictive Maintenance	1,981,000,000	990,400,000	50%
Storage Monitoring or	1,580,000,000 or	474,700,000 or	40%
Small Producer Coordination	2,900,000,000	1,457,000,000	40%
Total	**11,759,638,000-13,079,638,000**	**4,118,000,000-5,100,300,000**	

Source: A Case for Rural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision Ag Technologies. (April 2019). Available at https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

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[4] USDA NASS. 2017 Census of Agriculture State Profile. Available at https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/cp99031.pdf

[5] USDA. A Case for Rural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision Ag Technologies. (April 2019). Available at https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

Livestock and Dairy			
Technology	Potential Annual Gross Benefit	Potential Attributable to Broadband	% Dependent on Broadband
Fertility Planning	1,780,000,000	177,800,000	10%
Infanticide Prevention	9,800,000	4,900,000	50%
Livestock Records and Management	623,100,000	186,900,000	30%
Precision Feeding	4,100,000,000	1,200,000,000	29%
Mastitis Detection	143,300,000	14,300,000	10%
Audio/Visual Facility Monitoring	240,700,000	120,300,000	50%
Unmanned Herding	470,000,000	141,000,000	30%
Robotic Milking	2,050,000,000	613,400,000	30%
General Health Monitoring	8,800,000,000	4,400,000,000	50%
Automated Sorting	391,200,000	117,400,000	30%
Online Channels	1,004,400,000	502,200,000	50%
Tracing and Marketing	990,000,000	297,000,000	30%
Total	**20,602,500,000**	**7,775,200,000**	

Source: A Case for Rural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision Ag Technologies. (April 2019). Available at https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

Benefits of Next Generation Precision Ag Technologies to Farmers and Ranches

Next generation precision agriculture technologies provide farmers and ranchers with real-time data for decision-making. Here are examples of how farmers and ranchers in Nebraska are using real-time data for decision making:

- Farmers are using real-time data on precipitation to reduce irrigation, resulting in significant savings.
- Producers also use real-time data on wind speed and direction and documentation in order to safely spray dicambra.
- Livestock producers are using smart internet connected ear tags to monitor animal health and detect illness earlier and more accurately than visual observation.
- Cameras or monitors on water troughs can let ranchers check water supplies without having to travel to each location.
- The watering, cooling, feeding and disease management in confinement hog facilities can be managed offsite, reducing the risk of disease transmission.

Next generation precision agriculture technologies can reduce costs and increase productivity. The following tables show the potential benefits of a number of technologies and applications used by row crop farmers as well as livestock and dairy producers.

Row Crop Technology/Application	Estimated Potential Benefits
Yield Monitoring. Monitors on combines gather yield data, reducing input costs.	Saving $25 per acre in input costs for corn farmers
Precision Seeding/Variable Rate Seeding allows producers to optimize seed inputs: Typically for corn, seeding rates are increased in high productivity zones and decreased in low productivity zones.[6]	Saving $6.53 per acre on seed expenses
Connected Equipment Guidance. Vehicles use GPS to determine field boundaries for precise tending.	Saving $15 per acre on corn farms
Remote Diagnostics and Predictive Maintenance. Software can diagnose and anticipate needs for equipment repair.	Saving $5 to $15 per acre
Microclimate Monitoring. Satellites or on-site weather stations can monitor current weather conditions and forecast local weather more accurately. Accurate Information on local wind conditions can help reduce dicambra drift. Accurate information on rainfall can reduce unneeded irrigation.	Reducing crop loss by up to 80%
Field Scouting. Drone imagery or monitors in the field can collect nutritional and growth data used to calculate optimal inputs.	Saving $12 per acre on corn farms
Weed, pest and disease identification. Connected cameras and software can identify weeds, pests, and disease.	Reducing crop loss by 30%
Storage Monitoring. Temperature and moisture sensors can detect storage quality issues for stored grain.	Reducing crop loss and increasing sale price by $1 per hundred weight for grain sorghum
Small Producer Coordination. Small producers use web platforms to connect directly with buyers allowing them to earn premiums for meeting specific quality standards.	Increasing sale prices by $0.35-$0.51 per bushel for corn, soy, wheat and rice

Source (Except as Noted): USDA. (April 2019). Connected Technologies in Row Crops—A Case for Rural Broadband
https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

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[6] https://www.canr.msu.edu/news/the-art-and-science-of-variable-rate-seeding

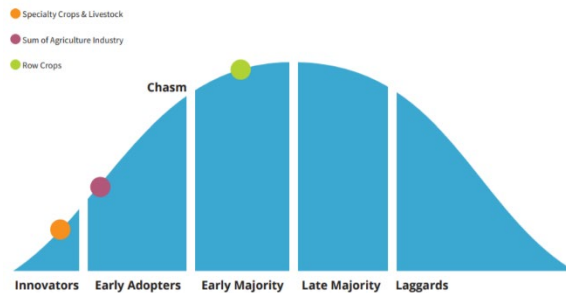| Livestock and Dairy Technology/Application	Estimated Potential Benefits
Fertility Planning. Biosensors can track ovulation and detect estrus with a 95% to 97% success rate.	Increasing pregnancy rates
Infanticide Prevention. Sensors can listen for sounds of distress and stimulate sows to reposition.	Reducing deaths by 75%
Livestock Records and Management. Producers can make decisions based on real-time herd data using record management software.	Reducing costs by $6 per 20 kg of production
Precision Feeding. Sensors can calibrate and distribute optimal amounts of feed.	Decreasing costs by $0.12 per day per cow
Mastitis Detection. Automated monitoring systems can detect early signs of mastitis.	Avoid $316 in indirect costs per infected cow per year
Audio/Video Facility Monitoring. Cameras and AI can help avoid or track lost animals.	Reducing labor time by 2.27 labor hours per 1000 pounds and 2 hours per broiler house per day.
Unmanned Herding. Unmanned Aerial Vehicles can monitor and herd	Reducing the cost of looking for lost cattle by 20%
Robotic Milking. Robots can sanitize and stimulate teats, self-attach to utters and catch milk.	Increasing production by 8%
Health Monitoring. Bluetooth-enabled animal wearables can monitor activity and detect anomalies.	Reducing medication by 15% per animal and shortening the cattle finishing process by 4 to 6 weeks
Automated Sorting. Visual inspection, weighing and quality sorting can optimize product price	Returning an additional $27 per day or $10,000 per year for a farm
Online Channels. Online cattle auctions	Returning 65% more revenue per unit of beef.
Tracing and Marketing. Technology can communicate key product attributes so consumers make informed purchases.	Providing a 15% premium compared to retail prices of commodity beef

Source (Except as Noted): USDA. (April 2019). Connected Technologies in Row Crops—A Case for Rural Broadband
https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

Next generation precision agriculture technologies also allow producers to spend more time with their families, improving their quality of life. For example, sensors, monitors and video cameras allow farmers and ranchers to check on their farms and ranches remotely, eliminating drive time.

Adoption of Next Generation Precision Ag Technologies

Connected agriculture technologies are in the early stages of adoption with row crop farmers on average being more advanced in their use of these technologies. The USDA estimates that row crop farmers are in the early majority stage of the technology adoption curve while specialty crops and livestock farmers are in the innovators stage.[7]

ESTIMATION OF AGRICULTURE ON THE TECHNOLOGY ADOPTION CURVE

- Specialty Crops & Livestock
- Sum of Agriculture Industry
- Row Crops

Chasm

Innovators   Early Adopters   Early Majority   Late Majority   Laggards

The use of next generation precision agriculture technologies by livestock producers in Nebraska is increasing. However, limited broadband availability over sparsely populated ranchland is a barrier to the adoption of these technologies by ranchers in Nebraska.

[Text Box]

Next Generation Precision Ag Technologies on the Ranch

A rancher may use broadband connectivity in several ways, including:

Marketing/Online Auctions. Hosting a cattle sale on the ranch requires reliable connectivity. A fiber connection with good upload speeds at the sale barn is preferable, although some livestock auction companies can run an online auction with a phone line in and a phone line out.

Advertising. Before the auction, still photos, videos and uploading to a catalog company in NW South Dakota; Facebook or webpage. A good upload connection at the home or ranch headquarters makes this easier.

Weighing. New scales have data capture capability and must have consistent broadband connections. A ranch may have several scales needing connectivity.

Watering. Cameras, drones or monitors can be used monitor troughs for water levels, ice and the availability of salt and minerals. Cameras require a high bandwidth connection. Monitors may require a low bandwidth connection such as LoRaWAN. A drone is an option to monitor areas without broadband.

As connectivity improves, ranchers may be more likely to use smart ear tags which monitors the overall health of animals and other technologies.

[End Text Box]

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[7] USDA. (April 2019). Connected Technologies in Row Crops—A Case for Rural . Broadband. Available at
https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf

Farm and Ranch Connectivity

A majority of farmers and ranchers in Nebraska (84%) and the U.S. (75%) have internet access[8] and recognize the importance of connectivity to their operations. A survey of over 2,000 U.S. farmers and ranchers by the United Soybean Board in 2018[9] found:

- 67% of farmers believe it is at least moderately important to be able to transfer data wirelessly from the field.
- Over 50% of farmers want to incorporate more data in their operations, but lack the connectivity to do it.

However, most farmers and ranchers do not believe that their internet service is adequate for their farm or ranch operations:[10]

- 60% of U.S. farmers and ranchers do not believe they have adequate internet connectivity to run their businesses.
- More than 60%of respondents consider internet connections to be inadequate, poor value, slow and/or unreliable.

Most farmers and ranchers use a smart phone, laptop, tablet or desktop computer:[11]

- 92% of farmers use smart phones and 59% use tablets.
- 66% use a laptop and 58% use a desktop computer in their offices.

Having a smart phone makes it easy for farmers to use apps for checking weather or getting market information on a daily basis. Many sensors, monitors and other devices connected to the Internet of Things (IoT) devices also have apps for smart phones.

Only 38% of rural Nebraskans have broadband available to them with broadband of 250 Mbps down and 25 Mbps up or greater. Less than one-fifth (18%) of rural Nebraskans have broadband available via fiber which offers the most reliable connectivity. Nebraska lags the U.S on the percent rural population with access to broadband at higher speeds (100/10 Mbps and 250/25 Mbps) and with fiber connectivity.[12] See the following table.

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[8] United States Department of Agriculture National Agricultural Statistics Service. (August 2019) Farm Computer Usage and Ownership. Available at https://downloads.usda.library.cornell.edu/usda-esmis/files/h128nd689/8910k592p/qz20t442b/fmpc0819.pdf

[9] United Soybean Board. (2019). Rural Broadband and the American Farmer: Connectivity Challenges Limit Agriculture's Impact and Sustainability. Available at https://api.unitedsoybean.org/uploads/documents/58546-1-ruralbroadband-whitepages-final.pdf

[10] United Soybean Board. (2019). Rural Broadband and the American Farmer: Connectivity Challenges Limit Agriculture's Impact and Sustainability. Available at https://api.unitedsoybean.org/uploads/documents/58546-1-ruralbroadband-whitepages-final.pdf

[11] United Soybean Board. (2019). Rural Broadband and the American Farmer: Connectivity Challenges Limit Agriculture's Impact and Sustainability. Available at https://api.unitedsoybean.org/uploads/documents/58546-1-ruralbroadband-whitepages-final.pdf

[12]Dec. 2019 Form 477 Data from the FCC Broadband Map at https://broadbandmap.fcc.gov

Area	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
United States	82.75	66.85	55.54	20.23
Nebraska	86.95	62.33	38.41	18.14

Source: Dec. 2019 Form 477 data, FCC Broadband Map at https://broadbandmap.fcc.gov

Rural areas of most Nebraska counties—including many of Nebraska's top-producing agricultural counties—lack broadband with upload speeds of greater than 25 Mbps or fiber connectivity. The table below shows broadband availability for the rural areas of Nebraska's top-producing agricultural counties.

% Rural Population with Broadband available (ADSL, Fiber, Cable, Fixed Wireless) Dec 2019 Top 10 Nebraska Counties by Agricultural Sales (2017)				
County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Cuming County	1,131,997	83.83	74.63	74.1	7.06
Custer County	781,155	53.02	7.21	0.13	3.25
Lincoln County	755,236	81.47	51.37	36.7	35.52
Dawson County	748,426	63.95	38.21	33.59	7.11
Platte County	688,562	95.06	72.08	56.61	1.26
Phelps County	578,241	85.9	62.42	60.18	37.16
Antelope County	529,502	80.12	44.25	8.46	17.45
Boone County	473,778	63.08	53.74	0	0
Holt County	453,539	75.41	16.31	0	16.31
Chase County	440,113	100	93.83	12.36	12.36

Source: FCC Broadband Map at https://broadbandmap.fcc.gov and USDA 2017 Census of Agriculture County Profiles at https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/

Connectivity Needs of Next Generation Precision Agriculture

Different methods of connectivity will likely be required for agriculture, including:

- Differential correction systems using satellite, Real Time Kinemetics (RTK) radio or mobile (cellular) for agricultural equipment with auto-guidance—This specialized system is widely available and widely used in Nebraska.
- Low-bandwidth connectivity for devices like sensors or monitors often called internet of things (IoT) devices
- High speed, centralized broadband for targeted agricultural operational headquarters such as a farm or ranch operations center
- High-speed decentralized coverage over large agricultural areas

The connectivity profile below provides additional details about types of internet connectivity needed.

Connectivity Profiles for Next Generation Precision Agriculture

	Low-Speed, Broad Coverage	High-Speed, Centralized	High-Speed, De-centralized
Geographic Coverage	Large areas (i.e., agricultural fields)	Targeted agricultural operational headquarters such as farm or ranch operations center, typically one site per producer.	Large areas (i.e., agricultural fields)
Network Speed	Slow (< 5 mb/sec)	Broadband and faster (25 mb/sec) +	Broadband and faster
Network Latency	High latency is tolerable	Low latency	Low latency
Upload/Download Speeds	Asymmetrical (faster download, slower upload) Expect small upload and downloads over time from many sensors and field devices	Symmetrical (same download and upload speeds) Expect large upload and downloads to support processing of large data files, and online training and support	Symmetrical Expect large uploads to transmit live video for remote monitoring and real-time decision making
Usage	• Transmit sensor data from fields • System automation and monitoring • Mobile access to systems and data for workers and decision makers	• Farm-level data aggregation and modeling • Raw data uploads for processing (drone and other sensor data) • Remote training and systems support • Online cattle auctions	• Field-level video streaming • Large uploads of HD videos and photos • Live video conferencing for support

Adapted from Examining Current and Future Connectivity Demand for Precision Agriculture Report Oct. 2020 by the Connectivity Working Group of the FCC's Precision Agriculture Committee pages 8-9
https://www.fcc.gov/sites/default/files/precision-ag-connectivity-demand-wg-report-10282020.pdf

Adoption of Irrigation Technologies Increasing

Irrigation plays an important role in Nebraska agriculture. Approximately one-third of Nebraska's farmland was irrigated in 2018. With 7.7 million irrigated acres, Nebraska ranks second in the number of irrigated acres in the United States, behind only California.[13]

Connected agriculture technologies can support irrigation scheduling through data from soil moisture sensors, plant moisture sensors, evapotranspiration measurement, and weather stations. Decision support software can use this data to help farmers make better irrigation systems. Farmers can more efficiently deliver irrigation using remote pivot controls and variable rate irrigation.

The percent of irrigated farms in Nebraska using soil moisture sensing devices increased from 22.9% in 2013 to 30.5% in 2018. Other technologies used included reports on crop-water evapotranspiration (21.2%), plant moisture sensing devices (2.1%), and computer simulation models (1.0%).[14] See the table below:

Technologies Used in Deciding When to Irrigate		
Technologies	**2013** **% of Irrigated** **Farms**	**2018** **% of Irrigated** **Farms**
Using Soil Moisture Sensing Device	22.9%	30.5%
Using Plant Moisture Sensing Device	0.3%	2.1%
Using Reports on Crop-water Evapotranspiration	24.1%	21.2%
Using Computer Simulation Models	0.7%	1.0%

Barriers to implementing irrigation water management technologies include lack of return on investment or lack of financing.[15] See the table below:

Barriers to Making Improvements to Reduce Energy Use or Conserve Water: 2018		
Barriers	**# of Farms** **Responding**	**% of Farms** **Responding**
Improvements will not reduce costs enough to cover installation costs	2,346	35.1%
Cannot finance improvements	2,037	30.4%
Investigating Improvements Not a Priority	1,879	28.1%
Landlord will not share in cost	1,305	19.5%
Risk of Reduced Yield or Poorer Crop Quality	800	12.0%
Physical field/crop condition limit system improvements	934	14.0%
Total Nebraska Farms Reporting Barriers to Making Improvements	**6,691**	

The cost of computers, control panels, and computer-controlled valves and hardware for irrigation water management per acre decreased from $19.56 per acre in 2013 to $10.20 per acre in 2018. Further reductions in costs should lead to greater adoption of irrigation control technologies.[16]

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13 USDA 2018 Farm and Ranch Irrigation Survey Table 2 Irrigated Farms by Acres Irrigated: 2018 and 2013
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris_1_0002_0002.pdf
14 USDA 2018 Farm and Ranch Irrigation Survey Table 23 Methods Used in Deciding When to Irrigate :2018
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris_1_0023_0023.pdf
15 USDA 2018 Farm and Ranch Irrigation Survey Table 25 Barriers to Making Improvements to Reduce Energy Use or Conserve Water: 2018
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris_1_0025_0025.pdf
16 USDA 2018 Farm and Ranch Irrigation Survey Table 16 Expenditures for Irrigation Equipment, Facilities, Computer Technology and Land Improvement: 2018
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris_1_0016_0016.pdf

Big Data

Next generation precision agriculture technologies generate huge amounts of data. "Agriculture will produce more data than all industries combined, " said Steve Tippery from RealmFive. [17] Researchers from The Ohio State University found that 100 acres of data generated 6 petabytes of data or 0.5 KB/plant in 2014.[18] Data generation by application[19] was:

- Spraying 0.3 MB/acre
- Planting 5.5 MB/acre
- Yield data 4.2 MB/acre
- Soil/Fertility Data 0.6 MB/acre
- Prescription Files 0.01 MB/acre

The amount of data generated per acre in 2021 and in the future may be even greater.

Farm and ranch data is generally stored and accessed in a cloud platform. Cloud computing can be used to aggregate data from tools like soil sensors, drones, and weather stations. Analytic capabilities and decision support in the cloud can also help farmers understand their production environment and make better decisions about managing their crops or livestock.

Farmers and ranchers need upload speeds of at least 30 Mbps to upload the immense amount of data generated to the cloud. In the future even greater upload speeds may be required. Symmetrical broadband would better meet the future needs of agriculture.

Much of the data generated is not currently usable or valuable to farmers. Data is often stored in file formats that require specialized software to read and access the data. Farmers also often do not have solutions that make it easy to analyze and act on the data. Because of these limitations, only 25% of the data generated is readily available to farmers, and only 11% of the data is valuable to farmers.[20] As solutions which make this data usable are developed and more widely used, the value proposition of next generation precision agriculture technologies will likely increase.

USDA 2013 Farm and Ranch Irrigation Survey Table 15 Expenditures for Irrigation Equipment, Facilities, Computer Technology and Land Improvement: 2018
https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris13_1_015_015.pdf

[17] Presentation to Rural Broadband Task Force Agriculture Subcommittee on Jan. 22, 2021.

[18] FarmBits Podcast. Feb.11, 2021. Episode 20: The Case for Connectivity (Interview with Dr. John Fulton, The Ohio State University). Available at https://www.youtube.com/watch?v=Gs79lMvo5ic&t=39s

[19] Shearer, S.A. 2014. Big Data: The Future of Precision Agriculture. Presented at The InfoAg Conference. St. Louis, MO, June. http://past.infoag.org/abstract_papers/papers/paper_233.pdf

[20] FarmBits Podcast. Feb.11, 2021. Episode 20: The Case for Connectivity (Interview with Dr. John Fulton, The Ohio State University). Available at https://www.youtube.com/watch?v=Gs79lMvo5ic&t=39s

Other Issues

Legal and technical issues—including data ownership and portability, right to repair, and technical standards and interoperability—may impede the full adoption of next generation precision agriculture technologies. Industry efforts to address these issues would likely accelerate the adoption of precision agriculture technologies.

Research and outreach efforts on best practices in connected agriculture technologies and the associated return on investment could accelerate adoption. Because farming varies from state to state and within regions of a state, research and outreach efforts should be localized and feature farmers and ranchers who are early adopters of next generation precision agriculture technologies.

Appendix
Broadband Availability and Agricultural Production in Nebraska Counties

Only 38% of rural Nebraskans have broadband available to them with upload speeds of 25 Mbps or greater. Only 18% of rural Nebraskans have broadband available via fiber which offers the most reliable connectivity.

| Area	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
United States	82.75	66.85	55.54	20.23
Nebraska	86.95	62.33	38.41	18.14

Source: FCC Broadband Map https://broadbandmap.fcc.gov

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Platte County	688,562,000	95.06	72.08	56.61	1.26
Phelps County	578,241,000	85.9	62.42	60.18	37.16
Antelope County	529,502,000	80.12	44.25	8.46	17.45
Boone County	473,778,000	63.08	53.74	0	0
Holt County	453,539,000	75.41	16.31	0	16.31
Chase County	440,113,000	100	93.83	12.36	12.36

Source: USDA 2017 Census of Agriculture County Profiles data available at
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/
and Dec 2019 FCC Form 477 data from the FCC Broadband Map at https://broadbandmap.fcc.gov

Broadband Availability and Top Nebraska Counties for Agriculture—Cattle and Calves Inventory
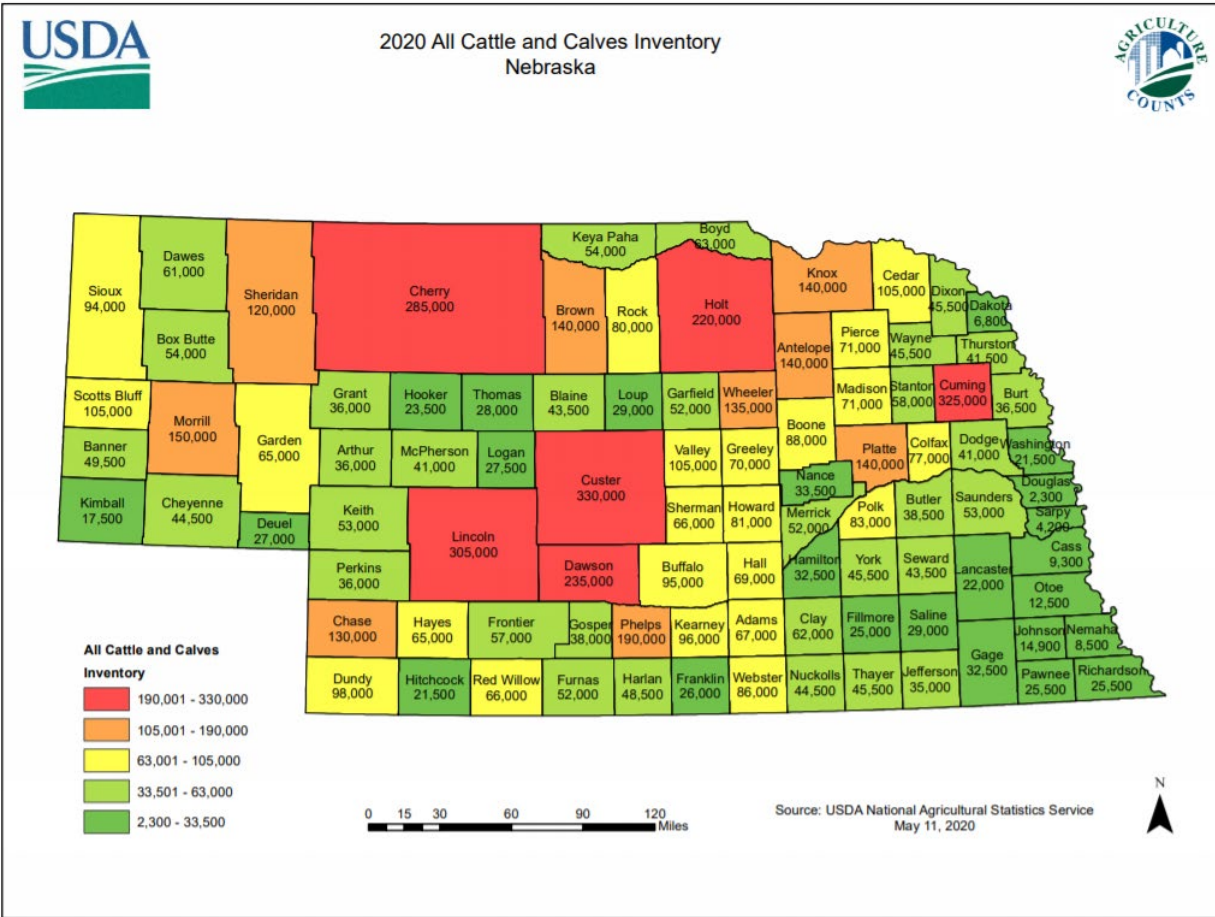
Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcattle.pdf

County	Cattle and Calves Inventory 2020	% rural pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec. 2019
Custer	330,000	53.02	7.21	0.13	3.25
Cuming	325,000	83.83	74.63	74.1	7.06
Lincoln	305,000	81.47	51.37	36.7	35.52
Cherry	285,000	41.88	12.33	0	11.54
Dawson	235,000	63.95	38.21	33.59	7.11
Holt	220,000	75.41	16.31	0	16.31
Phelps	190,000	85.9	62.42	60.18	37.16
Morrill	150,000	98.19	97.78	54.67	28.18
Antelope	140,000	80.12	44.25	8.46	17.45
Brown	140,000	26.8	16.82	0	16.82
Knox	140,000	51.93	0.18	0.18	0.18
Platte	140,000	95.06	72.08	56.61	1.26

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

Broadband Availability and Top Nebraska Counties for Agriculture—Corn Yield
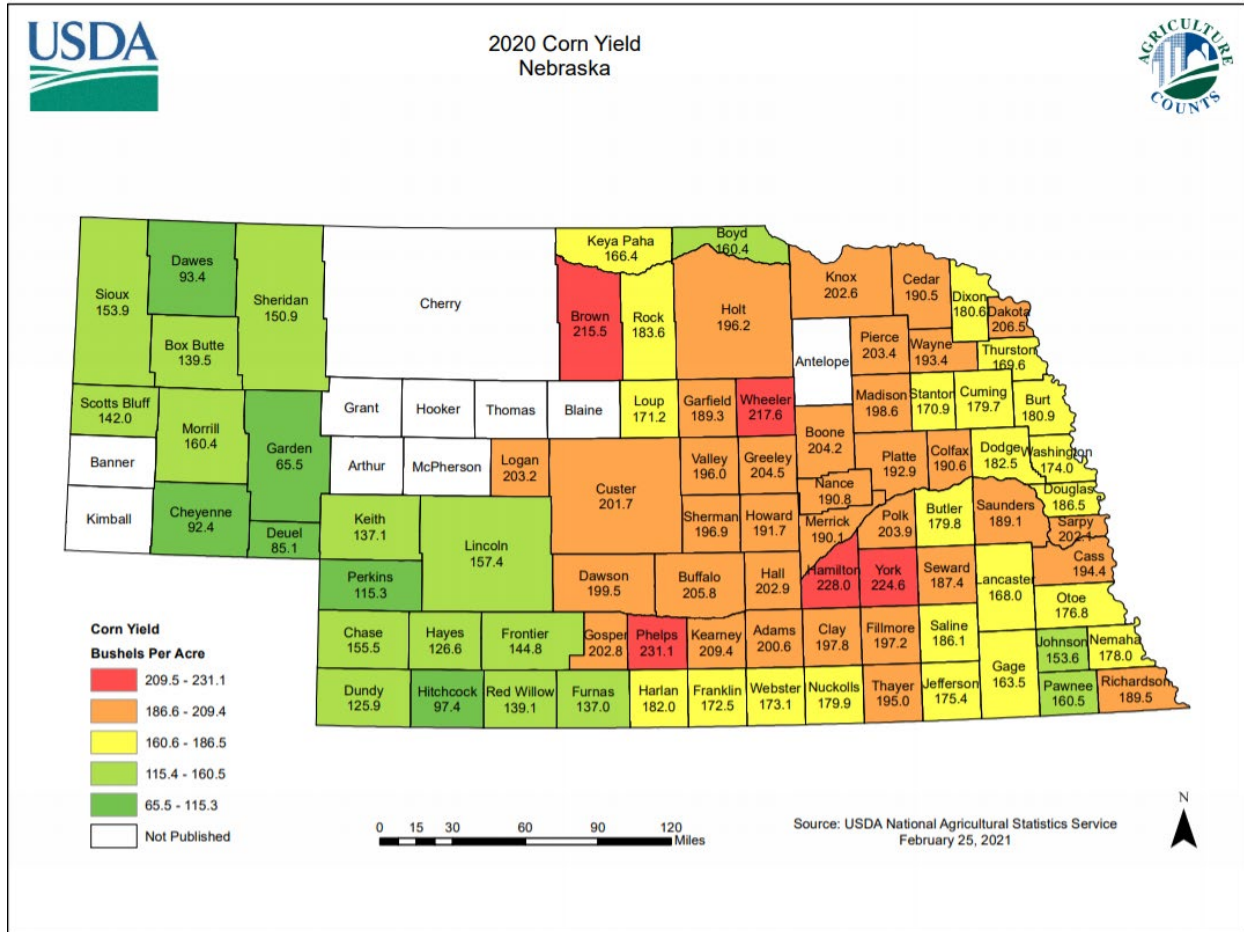
Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcorn.pdf

County	2020 Corn Yield Bushels Per Acre	% pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec/ 2019
Phelps	231.1	85.9	62.42	60.18	37.16
Hamilton	228.0	98.94	75.94	70.55	31.07
York	224.6	98.16	75.94	58.46	24.45
Wheeler	217.6	77.91	51.09	0	51.09
Brown	215.5	26.8	16.82	0	16.82
Kearney	209.4	81.8	57.41	57.41	18.06
Dakota	206.5	79.3	79.3	46.17	39.81
Buffalo	205.8	90.43	63.85	61.89	6.95
Greeley	204.5	35.65	21.05	0	2.08
Boone	204.2	63.08	53.74	0	0

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

Broadband Availability and Top Nebraska Counties for Agriculture—Soybean Yield
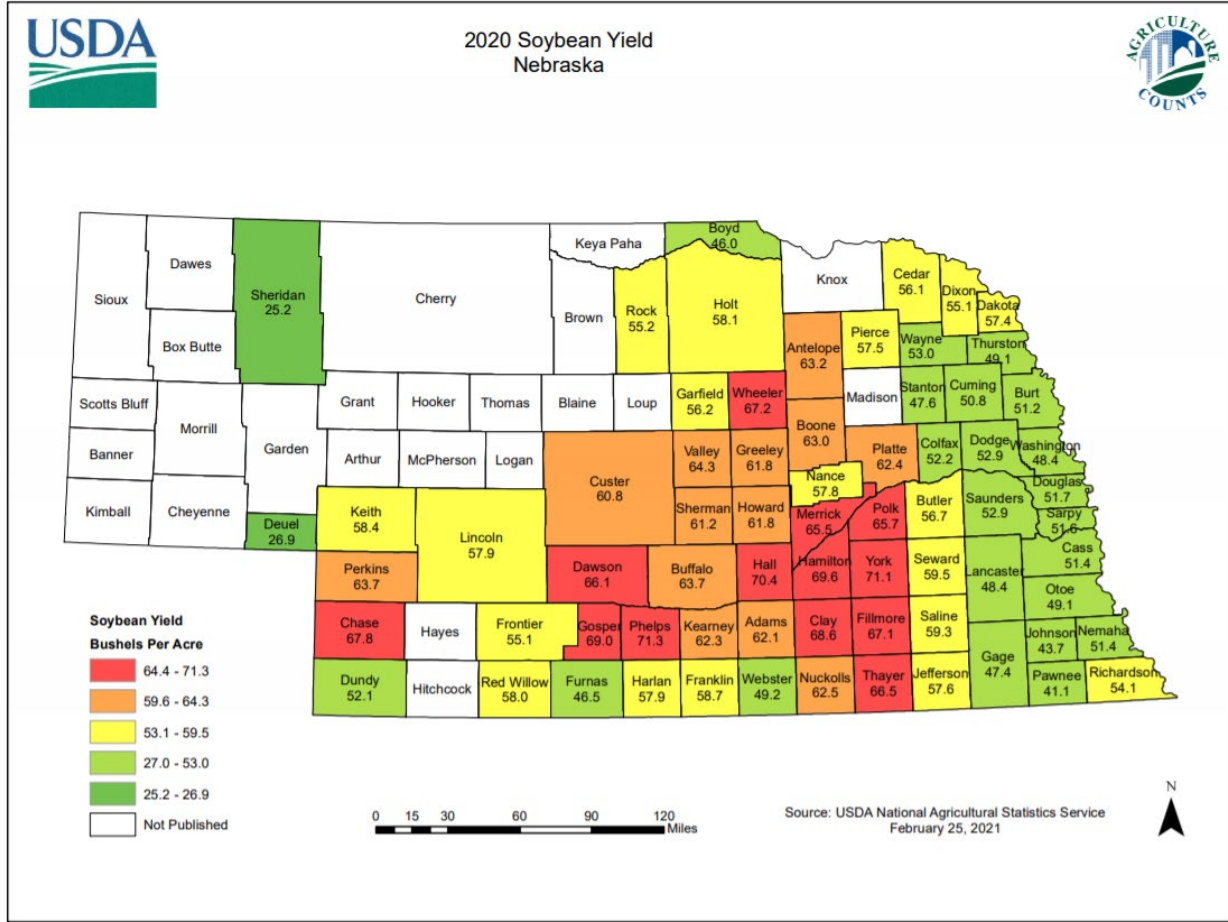
Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

County	2020 Soybean Yield Bushels Per Acre	% pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec/ 2019
Phelps	71.3	85.9	62.42	60.18	37.16
York	71.1	98.16	75.94	58.46	24.45
Hall	70.4	98.92	70.79	65.99	2.81
Hamilton	69.6	98.94	75.94	70.55	31.07
Gosper	69.0	52.51	12.51	12.46	0.05
Clay	68.6	74.29	44.29	13.03	5.71
Chase	67.8	100	93.83	12.36	12.36
Wheeler	67.2	77.91	51.09	0	51.09
Fillmore	67.1	84.11	61.52	44.43	5.03
Thayer	66.5	65.02	39.98	35.22	17.25

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

**Broadband Availability and Top Nebraska Counties for Agriculture—Cash Rent Irrigated Cropland**

Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcashrents.pdf

County	2020 Irrigated Cropland Cash Rent Paid Per Acre	% pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec/ 2019
Cuming	291.00	83.83	74.63	74.1	7.06
Dixon	285.00	92.37	88.61	29.9	44.23
Wayne	285.00	46.94	43.61	23.7	21.22
Cedar	282.00	65.53	64.78	22.01	42.79
Washington	282.00	100	30.25	4.25	5.92
Seward	277.00	100	88.25	70.57	11.64
Fillmore	275.00	84.11	61.52	44.43	5.03
Thurston	275.00	58.68	34.51	29.11	3.06
Boone	272.00	63.08	53.74	0	0
Dodge	270.00	100	74.63	51.37	23.56

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcashrents.pdf

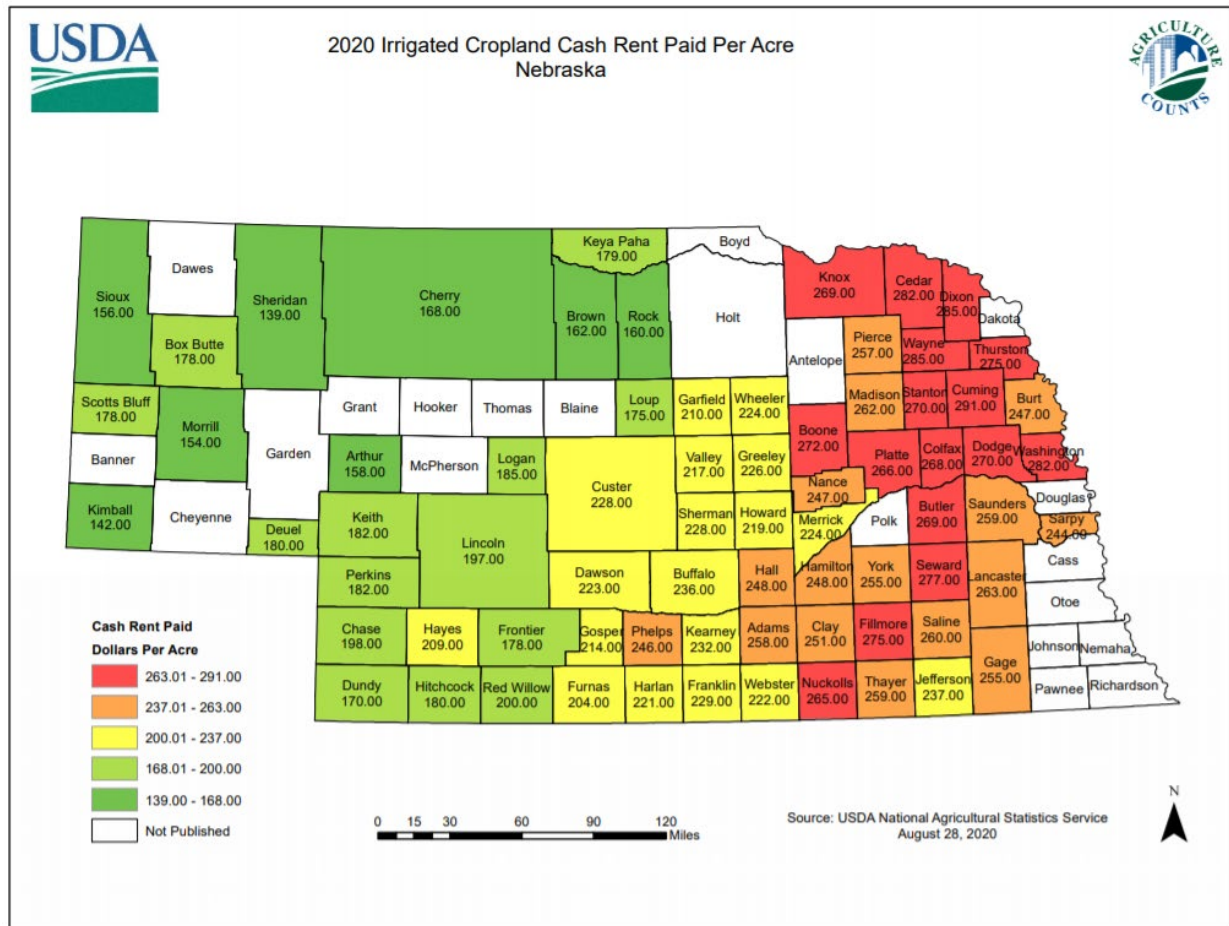**Broadband Availability and Top Nebraska Counties for Agriculture—Cash Rent Non-Irrigated Cropland**

Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcashrents.pdf

County	2020 Non-Irrigated Cropland Cash Rent Paid Per Acre	% pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec/ 2019
Cuming	243.00	83.83	74.63	74.1	7.06
Dakota	239.00	79.3	79.3	46.17	39.81
Thurston	238.00	58.68	34.51	29.11	3.06
Washington	225.00	100	30.25	4.25	5.92
Wayne	224.00	46.94	43.61	23.7	21.22
Dixon	223.00	92.37	88.61	29.9	44.23
Stanton	221.00	90.12	72.12	15.98	56.8
Burt	220.00	98.1	85.26	67.56	20.54
Cedar	219.00	65.53	64.78	22.01	42.79
Colfax	216.00	100	38.49	20.56	0.93

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

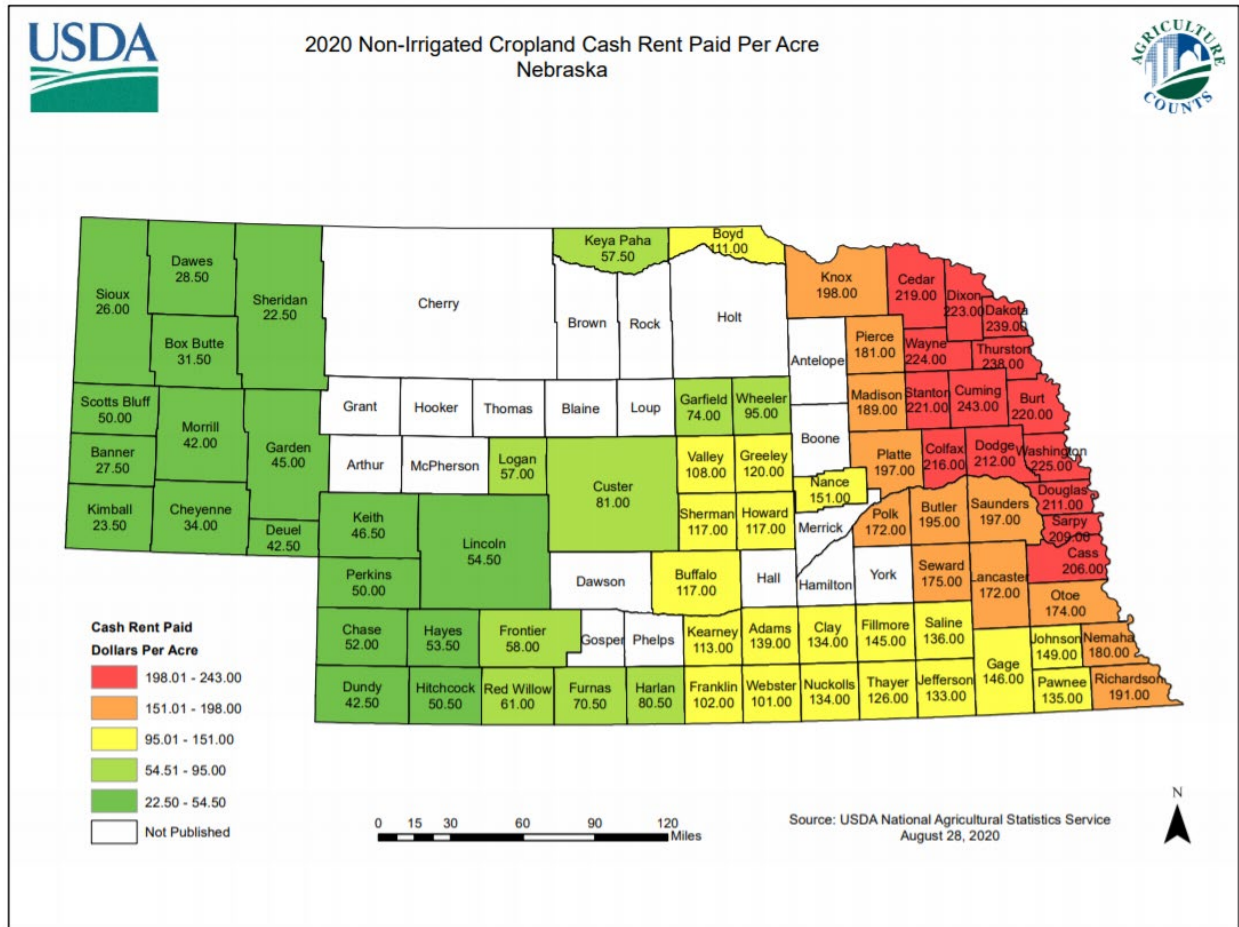**Broadband Availability and Top Nebraska Counties for Agriculture—Cash Rent Pasture Cropland**

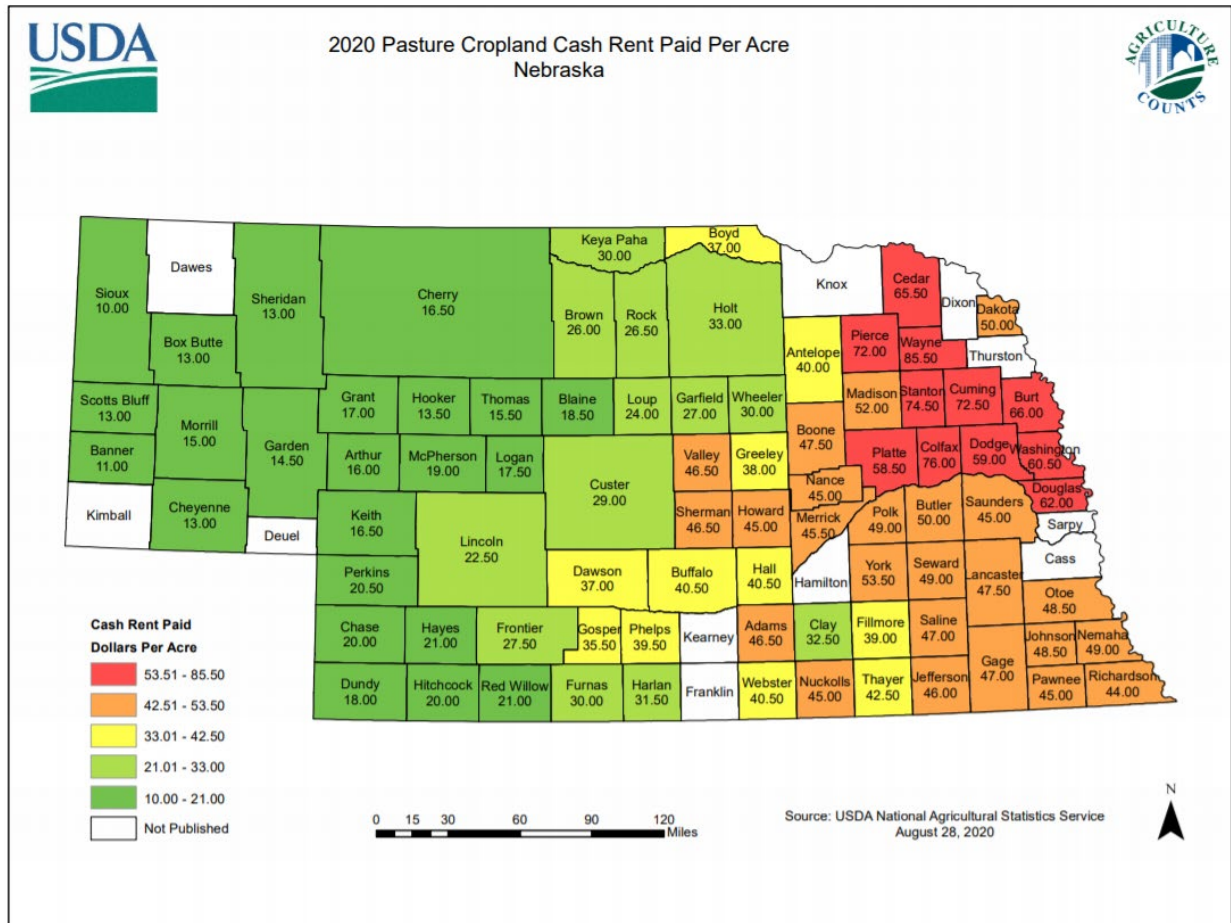Map available at https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEcashrents.pdf

County	2020 Pasture Cropland Cash Rent Paid Per Acre	% pop w/25/3 Dec. 2019	% rural pop w/100/10 Dec. 2019	% rural pop w/250/25 Dec. 2019	% rural pop w/fiber 100/10 Dec/ 2019
Wayne	85.50	46.94	43.61	23.7	21.22
Colfax	76.00	100	38.49	20.56	0.93
Stanton	74.50	90.12	72.12	15.98	56.8
Cuming	72.50	83.83	74.63	74.1	7.06
Pierce	72.00	81.27	68.93	68.4	31.25
Burt	66.00	98.1	85.26	67.56	20.54
Cedar	65.50	65.53	64.78	22.01	42.79
Douglas	62.00	100	86.03	71.11	36.15
Washington	60.50	100	30.25	4.25	5.92
Dodge	59.00	100	74.63	51.37	23.56

Source: FCC Broadband Map https://broadbandmap.fcc.gov and USDA National Agricultural Statistics Service
https://www.nass.usda.gov/Statistics_by_State/Nebraska/Publications/County_Estimates/20NEsoy.pdf

% Rural Population with Broadband Available (ADSL, Fiber, Cable, Fixed Wireless) Dec 2019 And Agricultural Sales (2017)					
County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Adams County	392,512	74.28	69.08	68.39	44.58
Antelope County	529,502	80.12	44.25	8.46	17.45
Arthur County	27,515	75.59	75.59	22.25	75.59
Banner County	100,509	98.79	98.79	0	0
Blaine County	32,055	48.39	36.56	0	36.56
Boone County	473,778	63.08	53.74	0	0
Box Butte County	176,933	94.14	94.14	76.03	75.96
Boyd County	104,269	99.43	68.84	0	68.84
Brown County	290,746	26.8	16.82	0	16.82
Buffalo County	332,712	90.43	63.85	61.89	6.95
Burt County	263,744	98.1	85.26	67.56	20.54
Butler County	259,765	100	79.69	58.62	13.84
Cass County	164,234	100	86.02	47.85	18.1
Cedar County	423,060	65.53	64.78	22.01	42.79
Chase County	440,113	100	93.83	12.36	12.36
Cherry County	230,927	41.88	12.33	0	11.54
Cheyenne County	163,932	88.39	85.99	8.86	0
Clay County	356,051	74.29	44.29	13.03	5.71
Colfax County	364,450	100	38.49	20.56	0.93
Cuming County	1,131,997	83.83	74.63	74.1	7.06
Custer County	781,155	53.02	7.21	0.13	3.25
Dakota County	84,954	79.3	79.3	46.17	39.81
Dawes County	60,933	67.33	51.4	41.77	42.27
Dawson County	748,426	63.95	38.21	33.59	7.11
Deuel County	71,317	94.09	69.29	0	0
Dixon County	271,575	92.37	88.61	29.9	44.23
Dodge County	270,502	100	74.63	51.37	23.56
Douglas County	55,535	100	86.03	71.11	36.15
Dundy County	161,137	96.1	0	0	0
Fillmore County	240,945	84.11	61.52	44.43	5.03
Franklin County	106,857	72	43.67	43.67	33.4
Frontier County	121,440	76.78	13.06	3.81	13.06
Furnas County	240,389	78.68	57.59	24.74	39.09
Gage County	280,173	90.12	48.24	10.9	15.69
Garden County	81,199	92.49	92.49	0	2.45

County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Garfield County	54,720	90.25	0.66	0.66	0
Gosper County	105,730	52.51	12.51	12.46	0.05
Grant County	24,129	69.34	23.6	0	23.6
Greeley County	193,340	35.65	21.05	0	2.08
Hall County	302,402	98.92	70.79	65.99	2.81
Hamilton County	275,749	98.94	75.94	70.55	31.07
Harlan County	160,274	75.59	5.77	0.74	5.77
Hayes County	167,234	87.66	2.4	0	0
Hitchcock County	59,623	97.43	0.29	0	0
Holt County	453,539	75.41	16.31	0	16.31
Hooker County	14,035	94.13	22.43	0	22.43
Howard County	235,183	81.16	47.59	41.37	0
Jefferson County	219,574	51.8	25.49	7.11	15.08
Johnson County	83,132	100	51.59	38.18	3.65
Kearney County	369,734	81.8	57.41	57.41	18.06
Keith County	161,853	88.49	74.49	44.01	45.04
Keya Paha County	52,332	96.53	7.2	0	6.7
Kimball County	39,975	97.05	95.57	68.45	0
Knox County	288,490	51.93	0.18	0.18	0.18
Lancaster County	188,834	100	84.32	48.54	28.04
Lincoln County	755,236	81.47	51.37	36.7	35.52
Logan County	28,614	23.66	0.27	0	0.27
Loup County	30,804	84.62	3.02	0	3.02
Madison County	276,087	90.96	61.62	51.72	4.2
McPherson County	28,399	51.82	10.32	7.49	10.32
Merrick County	240,328	90.61	63.85	28.52	17.01
Morrill County	319,692	98.19	97.78	54.67	28.18
Nance County	155,302	80.68	67.29	14.01	0.63
Nemaha County	114,427	100	46.88	5.72	14.4
Nuckolls County	147,522	74.06	67.24	62.15	61.45
Otoe County	170,523	100	66.3	28.77	5.11
Pawnee County	78,869	88.98	47.61	44.62	5.82
Perkins County	196,792	95.88	92.11	0	2.53
Phelps County	578,241	85.9	62.42	60.18	37.16
Pierce County	255,468	81.27	68.93	68.4	31.25
Platte County	688,562	95.06	72.08	56.61	1.26

County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Polk County	330,698	99.44	81.09	46.19	2.23
Red Willow County	188,195	96.55	25.72	14.31	14.31
Richardson County	149,348	99.21	80.79	23.99	61.65
Rock County	108,100	73.77	11.79	0	11.79
Saline County	206,909	98.95	79.87	52.25	1.84
Sarpy County	54,922	100	92.66	60.52	19.8
Saunders County	360,464	100	80.15	38.94	27.87
Scotts Bluff County	322,727	100	99.97	50.23	8.32
Seward County	250,954	100	88.25	70.57	11.64
Sheridan County	150,603	51.98	3.16	0.06	3.16
Sherman County	139,348	74.34	46.05	42.92	0
Sioux County	133,325	100	80.79	6	9.09
Stanton County	208,390	90.12	72.12	15.98	56.8
Thayer County	227,717	65.02	39.98	35.22	17.25
Thomas County	24,397	80.19	31.16	0	31.16
Thurston County	207,256	58.68	34.51	29.11	3.06
Valley County	223,891	78.14	51.42	51.42	0
Washington County	150,390	100	30.25	4.25	5.92
Wayne County	223,811	46.94	43.61	23.7	21.22
Webster County	347,852	56.12	53.63	49.56	50.42
Wheeler County	283,148	77.91	51.09	0	51.09
York County	340,896	98.16	75.94	58.46	24.45

Source: USDA 2017 Census of Agriculture County Profiles data available at
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/
and Dec 2019 FCC Form 477 data from the FCC Broadband Map at https://broadbandmap.fcc.gov

% Rural Population with Broadband available (ADSL, Fiber, Cable, Fixed Wireless) Dec 2019 By Agricultural Sales (2017)				
County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Cuming County	1,131,997	83.83	74.63	74.1	7.06
Custer County	781,155	53.02	7.21	0.13	3.25
Lincoln County	755,236	81.47	51.37	36.7	35.52
Dawson County	748,426	63.95	38.21	33.59	7.11
Platte County	688,562	95.06	72.08	56.61	1.26
Phelps County	578,241	85.9	62.42	60.18	37.16
Antelope County	529,502	80.12	44.25	8.46	17.45
Boone County	473,778	63.08	53.74	0	0
Holt County	453,539	75.41	16.31	0	16.31
Chase County	440,113	100	93.83	12.36	12.36
Cedar County	423,060	65.53	64.78	22.01	42.79
Adams County	392,512	74.28	69.08	68.39	44.58
Kearney County	369,734	81.8	57.41	57.41	18.06
Colfax County	364,450	100	38.49	20.56	0.93
Saunders County	360,464	100	80.15	38.94	27.87
Clay County	356,051	74.29	44.29	13.03	5.71
Webster County	347,852	56.12	53.63	49.56	50.42
York County	340,896	98.16	75.94	58.46	24.45
Buffalo County	332,712	90.43	63.85	61.89	6.95
Polk County	330,698	99.44	81.09	46.19	2.23
Scotts Bluff County	322,727	100	99.97	50.23	8.32
Morrill County	319,692	98.19	97.78	54.67	28.18
Hall County	302,402	98.92	70.79	65.99	2.81
Brown County	290,746	26.8	16.82	0	16.82
Knox County	288,490	51.93	0.18	0.18	0.18
Wheeler County	283,148	77.91	51.09	0	51.09
Gage County	280,173	90.12	48.24	10.9	15.69
Madison County	276,087	90.96	61.62	51.72	4.2
Hamilton County	275,749	98.94	75.94	70.55	31.07
Dixon County	271,575	92.37	88.61	29.9	44.23
Dodge County	270,502	100	74.63	51.37	23.56
Burt County	263,744	98.1	85.26	67.56	20.54
Butler County	259,765	100	79.69	58.62	13.84
Pierce County	255,468	81.27	68.93	68.4	31.25

County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Seward County	250,954	100	88.25	70.57	11.64
Fillmore County	240,945	84.11	61.52	44.43	5.03
Furnas County	240,389	78.68	57.59	24.74	39.09
Merrick County	240,328	90.61	63.85	28.52	17.01
Howard County	235,183	81.16	47.59	41.37	0
Cherry County	230,927	41.88	12.33	0	11.54
Thayer County	227,717	65.02	39.98	35.22	17.25
Valley County	223,891	78.14	51.42	51.42	0
Wayne County	223,811	46.94	43.61	23.7	21.22
Jefferson County	219,574	51.8	25.49	7.11	15.08
Stanton County	208,390	90.12	72.12	15.98	56.8
Thurston County	207,256	58.68	34.51	29.11	3.06
Saline County	206,909	98.95	79.87	52.25	1.84
Perkins County	196,792	95.88	92.11	0	2.53
Greeley County	193,340	35.65	21.05	0	2.08
Lancaster County	188,834	100	84.32	48.54	28.04
Red Willow County	188,195	96.55	25.72	14.31	14.31
Box Butte County	176,933	94.14	94.14	76.03	75.96
Otoe County	170,523	100	66.3	28.77	5.11
Hayes County	167,234	87.66	2.4	0	0
Cass County	164,234	100	86.02	47.85	18.1
Cheyenne County	163,932	88.39	85.99	8.86	0
Keith County	161,853	88.49	74.49	44.01	45.04
Dundy County	161,137	96.1	0	0	0
Harlan County	160,274	75.59	5.77	0.74	5.77
Nance County	155,302	80.68	67.29	14.01	0.63
Sheridan County	150,603	51.98	3.16	0.06	3.16
Washington County	150,390	100	30.25	4.25	5.92
Richardson County	149,348	99.21	80.79	23.99	61.65
Nuckolls County	147,522	74.06	67.24	62.15	61.45
Sherman County	139,348	74.34	46.05	42.92	0
Sioux County	133,325	100	80.79	6	9.09
Frontier County	121,440	76.78	13.06	3.81	13.06
Nemaha County	114,427	100	46.88	5.72	14.4
Rock County	108,100	73.77	11.79	0	11.79
Franklin County	106,857	72	43.67	43.67	33.4

County	Agricultural Sales ($1,000)	% Rural Pop with 25/3	% Rural Pop with 100/10	% Rural Pop with 250/25	% Rural Pop with 100/10 Fiber
Gosper County	105,730	52.51	12.51	12.46	0.05
Boyd County	104,269	99.43	68.84	0	68.84
Banner County	100,509	98.79	98.79	0	0
Dakota County	84,954	79.3	79.3	46.17	39.81
Johnson County	83,132	100	51.59	38.18	3.65
Garden County	81,199	92.49	92.49	0	2.45
Pawnee County	78,869	88.98	47.61	44.62	5.82
Deuel County	71,317	94.09	69.29	0	0
Dawes County	60,933	67.33	51.4	41.77	42.27
Hitchcock County	59,623	97.43	0.29	0	0
Douglas County	55,535	100	86.03	71.11	36.15
Sarpy County	54,922	100	92.66	60.52	19.8
Garfield County	54,720	90.25	0.66	0.66	0
Keya Paha County	52,332	96.53	7.2	0	6.7
Kimball County	39,975	97.05	95.57	68.45	0
Blaine County	32,055	48.39	36.56	0	36.56
Loup County	30,804	84.62	3.02	0	3.02
Logan County	28,614	23.66	0.27	0	0.27
McPherson County	28,399	51.82	10.32	7.49	10.32
Arthur County	27,515	75.59	75.59	22.25	75.59
Thomas County	24,397	80.19	31.16	0	31.16
Grant County	24,129	69.34	23.6	0	23.6
Hooker County	14,035	94.13	22.43	0	22.43

Source: USDA 2017 Census of Agriculture County Profiles data available at
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Nebraska/
and Dec 2019 FCC Form 477 data from the FCC Broadband Map at https://broadbandmap.fcc.gov