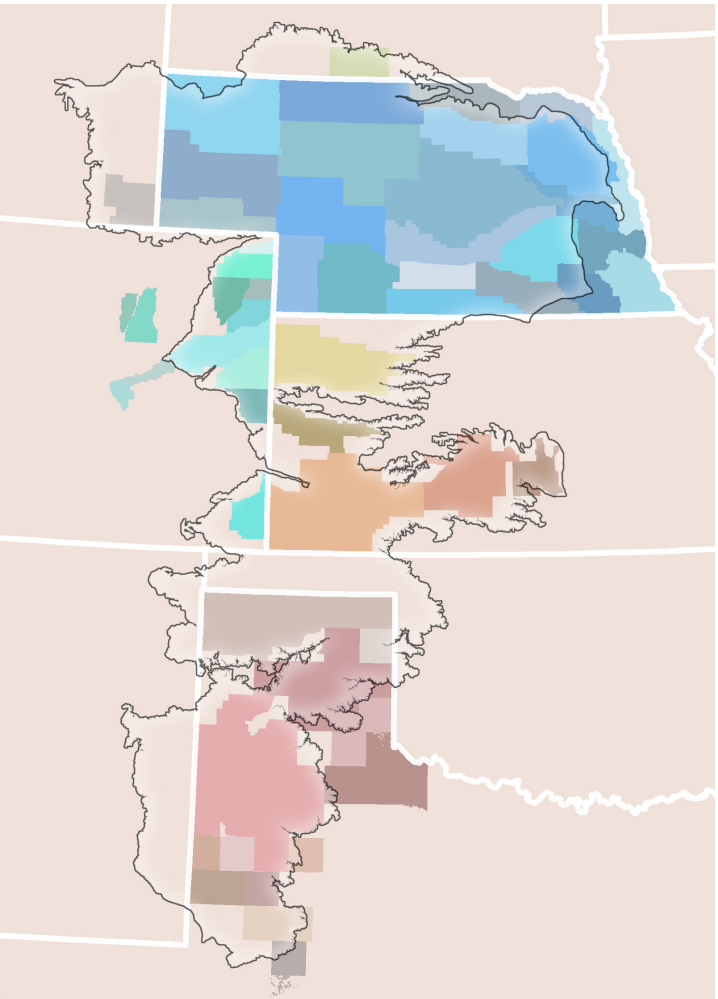
Ogallala Aquifer

S U M M I T

April 9-10, 2018
Summary Report



INTRODUCTION

The importance of groundwater used for agriculture and the dominance of agriculture as an economic driver in the Ogallala Aquifer region cannot be overstated. Given current levels of withdrawals from the aquifer and concerns with water quality, the decisions farmers and ranchers are making today related to water management will profoundly impact how tomorrow's producers will survive or thrive in the Ogallala region.

Where are we today and where are we headed with managing the Ogallala aquifer resource? Are there collaborative opportunities within and across state lines that could be leveraged to help address the region's water-related challenges? In April 2018, more than 200 water management leaders from all eight Ogallala states gathered in Garden City to discuss these questions at the Ogallala Aquifer Summit.

The Summit, which was focused on the theme *Cultivating Interstate Conversation,* was developed by a multi-state planning team led by staff from the 6-state USDA-NIFA funded Ogallala Water Coordinated Agriculture Project (CAP) and the Kansas Water Office. This event fulfilled an action item in Kansas' *Long-Term Vision for the Future of Water Supply in Kansas*, which calls for bringing together water management leaders from states overlying the aquifer to explore interstate opportunities for managing the aquifer for benefit of the Ogallala communities and the agricultural industry. Meanwhile, the Ogallala Water CAP was funded by USDA-NIFA to engage in and encourage interstate and interdisciplinary exchange in order to boost our understanding and adoption of productive and profitable strategies for water management in the region.

Summit participants included producers, commodity leaders, representatives from water management districts, technology companies, Federal agencies and non-profits, researchers, students, policy makers, and elected officials. Over two days, the group exchanged expertise and perspectives on effective management practices and support systems (local, state, and Federal policies, incentive and educational programs, markets, etc.) with potential to conserve water and sustain the Ogallala region's agricultural productivity.

The meeting's format of keynotes, panels, and workshops covering information on producer practices, science, and policy fed into a final, capstone workshop in which participants identified important cross-state relationships and prioritized activities that could be acted upon in the near term (over the next 12-36 months) with potential to benefit the region over the long term. This report provides an overview of the panels and input shared by participants during the Summit's workshops.

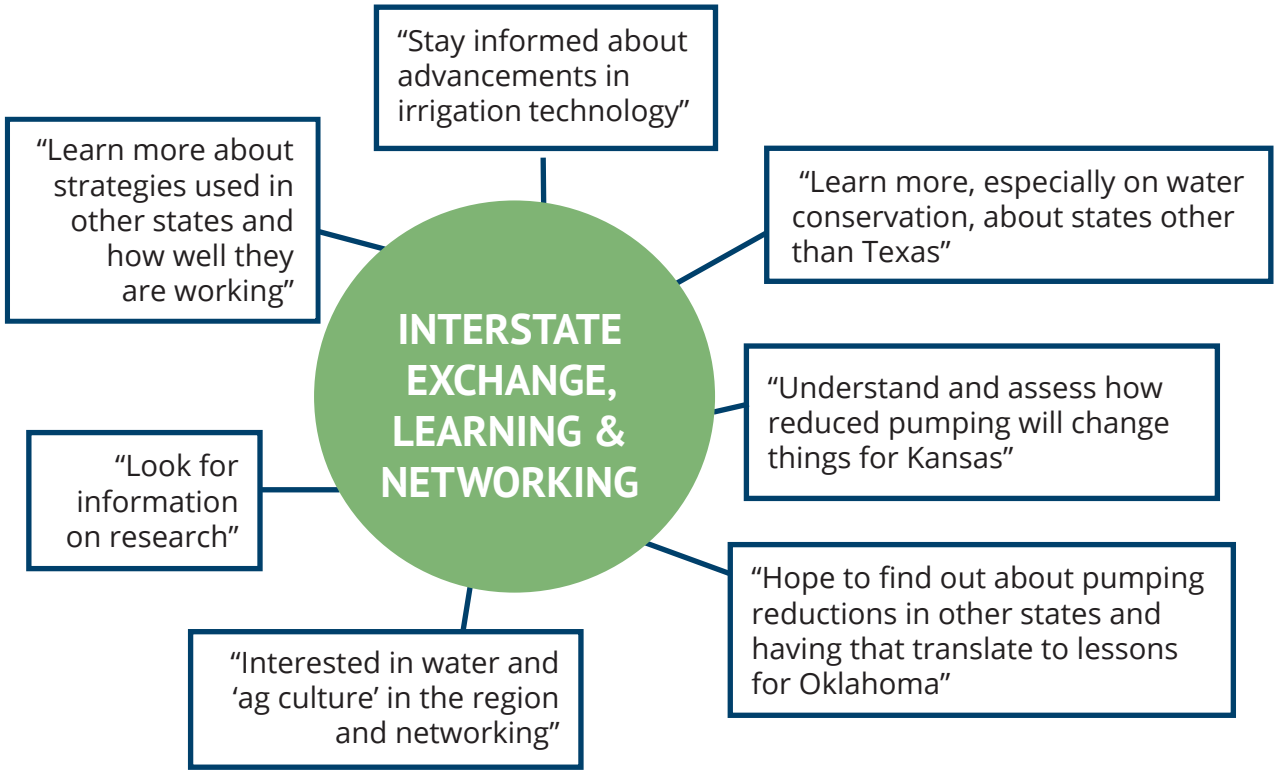
For links to Summit white papers, mainstream media coverage, and videos from the event, -please visit: http://ogallalawater.org/2018-ogallala-aquifer-summit/.

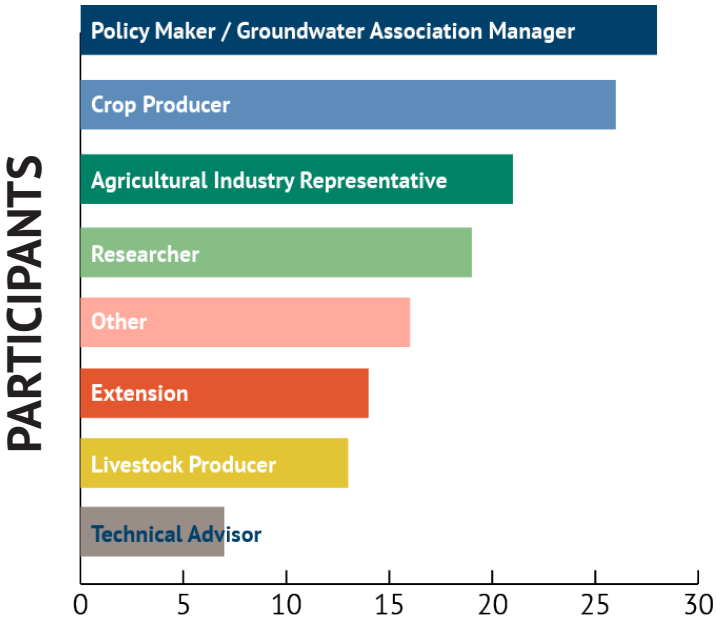
Special thanks:

Morgan Marley: *Summit report layout and graphic design*
Ryan Golten**:** *Consensus Building Institute & Summit lead facilitator*
Katie Ingels, Bailey Hittle, Jim Butler, Chuck West, and Ron Lacewell: *text review*
Summit table facilitators and notetakers*: names are listed at the link above*

WHY SUMMIT ATTENDEES CAME

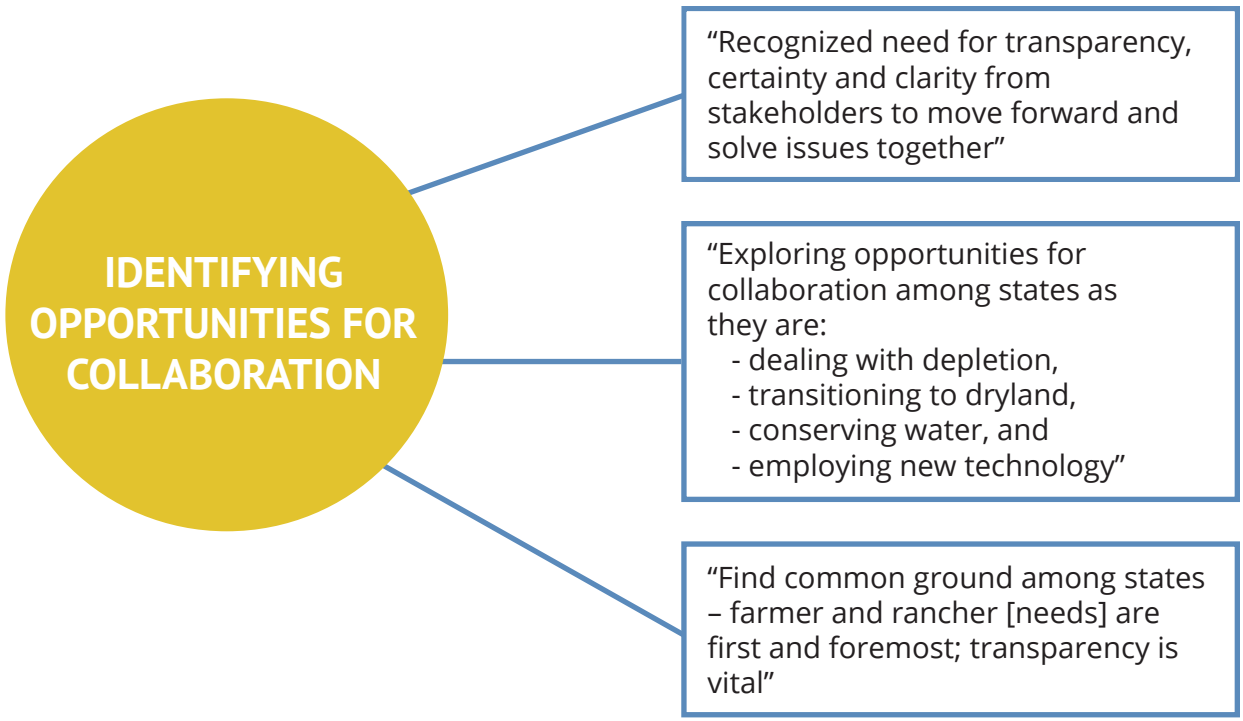
Question 1: Icebreaker
What did you most hope to achieve by attending this Summit?



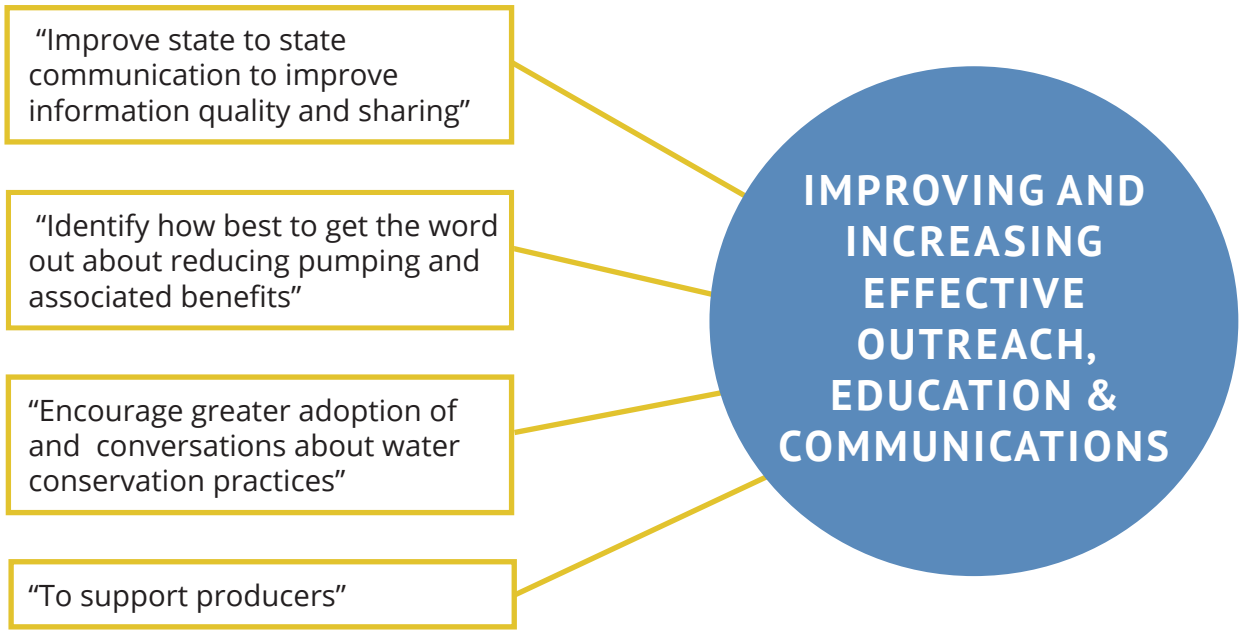


Bar graph shows data from Summit evaluations (n = 106)

Notes: *Other* represents campaign representative, state or government employee, non-profit representative, youth water advocate, FFA representative, consultant, communicator, student. Some participants checked multiple roles.



> ***"Relationships are how we solve problems and take on challenges, and goodness knows we have some challenges when it comes to water."***
> ***– Jackie McClaskey, KS Secretary of Agriculture***



Question 2: What is your greatest hope and/or fear for the Ogallala Aquifer Region going into the future?

CONCERNS	*HOPES*
Need to slow aquifer decline and prevent contraction of regional economy	Prevent depletion and extend viable use of aquifer as long as possible
Impact on ag communities if pumping is no longer economical	Avoid avoidable disaster – make viable transition pathways visible
Avoid outside intervention (State and Federal)	Increased effective local leadership on water planning and management
Conservation and management shifts are costly	Conservation and management shifts save money, water, and time
What good is my effort if others don't also engage similarly?	Local shifts in practice affect the aquifer locally. Prioritizing conservation can have short- and long-term advantages if returns on inputs used are maximized.
Need more focus on water quality	Water and nitrogen use are linked. Increase the visibility of input use efficient practices

Left to right:
Jim Reese (OK Secretary of Agriculture), Jackie McClaskey (KS Secretary of Agriculture), and Don Brown (CO Commissioner of Agriculture) at the Summit.
Photo courtesy of Jennifer M. Latzke, High Plains Journal.

KEY SUMMIT TAKEAWAYS

The following information is a condensed version of input generated at the Summit's 21 tables of participants during facilitated workshop sessions. This information represents the collective expertise and perspective of Summit participants, who, as water management leaders in the region, were asked to identify actionable steps moving forward on a interstate basis that could meaningfully impact the region in its efforts to manage its water related challenges.

More Collaboration Could Benefit Ogallala States

Supplying 30% of the U.S.'s agricultural output and representing 10% of U.S. farms, there are many reasons for Ogallala states to work collaboratively to achieve common goals of slowing groundwater depletion. Working together, Ogallala states might shape direction and application of Federal programs (NRCS's EQIP, with FSA, RMA, etc.) with implications for water conservation incentives and opportunities tailored to the unique growing conditions and constraints of the High Plains. Summit participants suggested the following key areas for interstate collaboration:

Offer producers greater flexibility by investing in research funding and broader support for a wider range of water-use efficient crops. Build on the success of USDA-ARS funded Ogallala Aquifer Program to include participation by researchers based in other Ogallala states in addition to those in Kansas and Texas.

Inform and improve local, state and Federal policies that (sometimes inadvertently) incentivize depletion of the aquifer, by merging and increasing exchange within networks of existing multi-state groups such as Western States Water Council, Groundwater Management Districts Association, USGS, USDA-NIFA funded Ogallala Water Coordinated Agriculture Project, USDA-ARS funded Ogallala Aquifer Program, the newly funded Irrigation Innovation Consortium (FFAR) and FFA/4-H.

Use social media and other outreach efforts to raise the general visibility and understanding of the value of production and water used in the Ogallala region.

Work together to leverage cost-share dollars through federal programs to incentivize broader scale adoption of water saving tools and practices.

Focus on Shifting Mindsets & Priorities from Maximizing Yield to Maximizing ROI

Shift research, policy, education, and outreach to a systems approach of "maximizing returns on inputs used" rather than "maximizing yields" can benefit producers' bottom lines while saving water and reducing input and other production costs.

Having Data Helps

Data on water use and water levels is an essential tool for individuals as well as for local, state and Federal investment and program development. On farms, having access to this kind of data, along with water and energy audits of irrigation systems can help save water AND money

Increase Interstate Communication

Use consistent and effective messaging to bring greater visibility and to "normalize" conservation practices and technology embraced by early adopters, e.g. irrigation scheduling or soil water monitoring.

Continue and expand 8-state conversation by including a wider range of stakeholders who influence and are impacted by water management decisions.

Raise visibility for the general public, through social media and other outreach efforts, of how important and valuable irrigated commodity production is for the Ogallala region's economies, communities, and for overall U.S. agricultural output, today and into the future.

Establish a shared region-wide vocabulary that fosters effective communication about the region's water related challenges among stakeholders—including producers, tech company representatives, crop advisors, academics, and local, state and Federal agencies, ag lenders, multinational companies, absentee landowners, and others.

Summit participants discussed how local control over water management is crucial, along with support for local decision making in the form of policies (voluntary and mandatory) implemented within districts or at the state level.

Investment Opportunities

Consumers' increasing interest in understanding how their food is produced has led to the development of large-scale sustainability inititatives at many multinational companies. These initiatives sometimes include traceability programs in which participating producers can track and provide transparency in terms of their input use (including water) and other effective management strategies such as those related to protecting and encouraging soil health, for example. In exchange, the producers may lock in favorable contracts for their products, the capacity to share their farm's story with a large-scale audience through positive branding, and/or become eligible for cost-share incentives through adopting certain practices and tools.

Improving pasture and stacking of alternate economies (wind, solar, etc.) could be especially important in areas where the projected time horizon for pumping is limited.

Practice + Policy Encourages Adaptation and Increases Adoption

Increase education, incentives, and adoption of rapidly emerging irrigation management technologies with the potential to transform agriculture. Ensure that improvements in water and other input use efficiencies, when combined with other agronomic and irrigation management strategies, do not lead to greater overall water use in the region.

Expand farmer-to-farmer demonstration to encourage interest in and adoption of tools and strategies for increasing water use efficiency and water conservation. Programs and events that feature peer-to-peer learning and exchange attract high levels of engagement by producers, researchers, tech companies, and other stakeholders interested in finding ways to increase effective water management while maintaining producer profitability.

Form and highlight a network of producer pioneers across the region and the range of practices they employ so that they can provide helpful examples to others and also benefit from belonging to a peer group of agricultural leaders.

Identify and develop strategies to overcome barriers related to adopting effective water management practices and tools, perhaps with special emphasis on those which are not cost- or time-intensive: "There's a list of about a dozen things we could be doing different everywhere". Adoption of these practices and tools is still modest across the region, which means potentially a significant amount of water savings might be achievable in the region without impacting productivity.

Develop locally defined and administered water management priorities, including regulations, to induce shifts in water management so that water conservation and overall system efficiency becomes prioritized while maintaining profitability.

> ***"Ag has a great story to tell. For example, over just my lifetime, with the amount of water that used to be used to raise a pound of cotton, you can produce 3 pounds... Never underestimate the power of technology and free enterprise. If there's an ability to make a profit, someone will come up with better solutions."***
> ***– Ronnie Hopper, Texas Panhandle Producer***

INTRODUCTORY SESSIONS

Kansas Lieutenant Governor Tracey Mann's welcome address to the Summit audience of nearly 210 people highlighted the value of water and water conservation in western Kansas and throughout the Ogallala region for the long-range economic security of the region and its future generations. Mann, noting Kansas' dependence on agriculture and the stark contrast in precipitation and water availability in western and eastern parts of the state said, "If the Ogallala is to deplete in our lifetime, this will make life fairly hard. And in the areas where depletion is inevitable, there's a sense that 'we've got to extend it long enough to adjust."

Mann's remarks were followed by an introductory panel moderated by John Stulp, special water policy advisor to Colorado Governor Hickenlooper. The panelists, Jesse Bradley (Assistant Director of the Nebraska Department of Natural Resources), Don Brown (Colorado Commissioner of Agriculture) and Jackie McClaskey (Kansas Secretary of Agriculture) shared insights gleaned from their collective work to respect Republican River Compact-related commitments and described their states' programming and funding support related to water management. As an illustrative example relevant to the Ogallala region, Secretary McClaskey pointed out that the region's often contentious water-related interstate conflicts in past decades have since given rise to constructive and amiable interstate working relationships that can be leveraged to encourage effective management of the Ogallala aquifer resource.

> ***"We've been working on issues that years ago we thought were unsolvable, but what we do [today] is about the next generation, and preserving the small communities they grow up in. Without cooperation, we will not get there."***
> ***– Don Brown, CO Commissioner of Agriculture***

Watch: ***Robert Mace's (Meadows Center for Water and the Environment) introductory keynote: "From the Great American Desert to the Great American Breadbasket: Managing Groundwater in the High Plains Aquifer"***
http://ogallalawater.org/2018-ogallala-aquifer-summit/

Summit participants were assigned seats to ensure they would meet and exchange with people representing different states and stakeholder perspectives.

Interactive Summit Workshop

- *What do you see as some of the **best opportunities** for the region going forward to sustain agricultural productivity related to water?*
- *What is standing in the way or **needs to be addressed** in order for these opportunities to be realized?*

Barrier: **People are resistant to change.** "People are wary until new methods and equipment are proven." ***Opportunities:*** Recognize and reward producer "conservation leaders" who focus on systems management to maximize return on inputs used, raising the visibility of farmer stories to convey what has and hasn't worked, and why. Shift local, state and Federal regulations to incentivize and reward technology adoption (hardware and software) that fit into profitable, water-use efficient and conservation-oriented operations. Encourage voluntary measures that lead to shifts in mindset and practice; these are preferable to regulatory or legal activities that force behavioral change. "When given enough time and reasonable restrictions, producers adapt." New mobile apps, data streams, and online dashboards used in different crop and livestock systems can help farmers target, track, and budget their use of inputs, including water, in (near) real time in ways not yet possible even just 5-10 years ago.

Barrier: **Make the adoption of technology and other management practices affordable.** "On a $5-$20 million-dollar operation, the decision to spend $1/acre to add telemetry, soil moisture probes, etc. is a big one. Technologies have to work and pencil out." ***Opportunities:*** Each farm is a unique system for which a range of proven tools, including older and newer technologies (drag lines, bubblers, soil moisture probes, variable frequency drives, variable rate systems, drip, irrigation schedulers, telemetry for remote monitoring, etc.) requiring different levels of investment may be suitable in helping to optimize water use and decrease input and management costs. "There is no one size fits all solution. If producers know that adopting a new practice or technology will keep money in their pockets, they will make the shift." More information, research data, and market support are needed for crops (including for high-value crops and drought-tolerant genetics that meet livestock needs) suited to limited irrigation capacity and dryland systems. Leverage partnership opportunities with (multi-national) companies increasingly pushed by consumers to source agricultural products from sustainable systems.

Barrier: **More visibility, education, and support of effective water-use and water conservation practices and technologies is needed.** "For bankers and absentee landowners, investment in technology and other management strategies may look like a luxury in a low cash environment." ***Opportunities:*** Throughout the Ogallala region, replicate programs that emphasize peer-to-peer exchange and close working relationships with researchers, tech providers, and others (for example, see Master Irrigator program, page 18 and TAPS, page 14). Bring non-producers, including absentee owners and ag lenders, into discussions on the value of extending the aquifer resource. Train and reward crop consultants who help producers achieve greater water use efficiency and conservation while maintaining productivity and cash returns.

PRODUCER PANEL

Water-wise Strategies for Sustainable Production

The Summit's producer panelists represented a range of farm sizes and production types (crop, dairy and livestock) but they are all similar in terms of being innovative and highly engaged in systems-level approaches to optimizing water management on their operations.

Roric Paulman (Paulman Farms, Sutherland, NE) operates a diversified farm located in three of Nebraska's Natural Resource Districts (NRD). Paulman farms has implemented water conservation-oriented practices for 35 years in response to allocation restrictions in one NRD. To "leave a legacy of water" for future generations, Paulman Farms: 1) invests ~$22/acre annually on advanced irrigation-related equipment; 2) serves as a demonstration site to help others see how the tech works in action; and 3) accounts for all operational processes, including crop rotations, water and other inputs applied, to assess a net return on investment and to address demands for increased product traceability. Hope for the future: would like to see the multitude of current management apps merged into a single decision support tool for irrigation management.

Kyle Averhoff (Royal Farms and Noble Dairies, Garden City, KS) oversees an operation that milks 9300 cows and raises 10,000 heifers across two dairies located 20 miles apart, including crop production and dairy processing. The two dairies face a dramatically different water picture in terms of their saturation thicknesses and depletion rate. "We like to make money and to milk cows, and we're forward looking, trying to do what's right for today, tomorrow, for the community and balance sheet, bringing as much value to the water use as possible." Innovation: Waste water and rainfall stored in lagoons are applied to this 3600 acres of crop fields (representing about 2.5" of applied irrigation/ year) bringing the operation's net water consumption to 250 acre-feet annually.

R.N. Hopper and Ronnie Hopper (Petersburg, TX) are father and son continuous no-till producers invested in conserving water through responsible and beneficial use, building soil health, reducing inputs, mimicking natural systems. With declining water supplies, the Hoppers are focused on stabilizing soils using what water they have left and developing production practices so that they can shift effectively to dryland production once irrigation is no longer possible. Through their involvement in the High Plains Underground Ground Water Conservation District in the TX Panhandle and in helping to lead the organization No-till TX, both Ronnie and R.N. stressed the value of collaboration and exchange among producers and with other groups to identify viable transition pathways for producers with dwindling groundwater.

> ***"As soil health declines, we cover up [field management] mistakes with water. As soil health improves, water holding capacity improves."***
> ***– R.N. Hopper, Texas Panhandle Producer***

Tom Jones (Manager/Owner of HyPlains feedyard, Garden City, KS) feeds 100,000 head of beef cattle annually. This operation has about 25 years left of water remaining with current practices. Strategies to reduce water use include: 1) optimizing genetic selection and animal health; 2) closely monitoring cattle, selecting for those that eat the least and gain the most; and 3) shifting herds to grazing to reduce costs of production and save water. For HyPlains, "sustainability" means increasing predictability through increasing animal efficiency and health, achieving desired profit margins, and improving traceability and effective marketing strategies.

Darren Buck (Elkhart, KS). Buck's century family farm started as a homestead in Baca County, CO. Today, his farm produces crops in southwest Kansas and the Oklahoma Panhandle on land with saturated thickness ranging from 75-250 feet. "We are staring at the end of the useful life of the aquifer here," he said. Buck has a background in economics and sees food production from a producer's and consumer's perspective as a pizza shop owner. Buck noted that "farmers have instant street cred with non-farmers, but we really have to do a better job of telling our story" about what farming involves and farmers' stewardship efforts. He also pointed out that "small savings on many farms can add up quickly. See blue box below for five basic water saving practices Buck has implemented on his farm.

5 WATER SAVING PRACTICES IMPLEMENTED AT BUCK FARMS

- Shifting from conventional tillage to no-till on dry land and strip till on irrigated acres immediately lowered production costs and water use
- Adding telemetry to all center pivots enabled improved monitoring and control.
- Checking pivots online regularly and addressing alerts immediately. "If a pivot has a problem at 1 a.m. we go out to fix the problem and shut the well off if we have to. One pivot stuck for 10 hours is millions of gallons of water, enough for my town of 2,000 people for a year."
- Improving track management to prevent pivots from getting stuck. With pivots running 1500 to 2000+ hours/year on clay loam soils you can expect tracks to develop. More than once a year, Buck fills tracks so that they can shut down or restart pivots as needed to save water.
- Adopting use of soil moisture probes.

Kansas's Water Technology Farms program showcased at Summit evening social

Farmers Dwane Roth and Tom Willis discussed their farms' water conservation methods, while drone footage of Water Tech Farms played on the big screen behind them. This event, hosted at Garden City's movie theater, provided a fun and valuable networking/learning opportunity for Summit participants.

More info on Water Tech Farms: https://kwo.ks.gov/projects/water-technology-farms

SCIENCE PANEL

Science and Data in Action

The science panel was designed to provide a snapshot of current research from across the aquifer region that is informing groundwater management.

Jim Butler (Kansas Geological Survey, KGS) stated that pumping reductions can moderate the rate of decline of the Ogallala aquifer. The key question, however, is how much pumping reduction is needed? Two types of data collected in Kansas – on how water levels have changed over time and water use – are used in the KGS's modeling framework to answer this question. The Kansas Department of Agriculture's Division of Water Resources and the KGS measure water levels in 1,400 wells each January so that year-to-year variations in the end of the growing season has little effect on the data collected. For water use data, almost every non-domestic well in western Kansas has a totalizing flow meter whose information is submitted and evaluated annually (this is ~27,000 wells). The KGS model estimates that, to stabilize the aquifer levels, pumping must be reduced by about 30% in the groundwater management districts (GMD) overlying the Ogallala aquifer. With this information, GMDs can set target rates of decline and identify the corresponding pumping reductions that would be needed to achieve stated goals. Even modest reductions in pumping can positively impact the aquifer.

> ***"Heavy use of the Ogallala aquifer has led to significant depletions. If we do nothing, we know where we're going to end up."***
> ***- Jim Butler, Kansas Geological Survey***

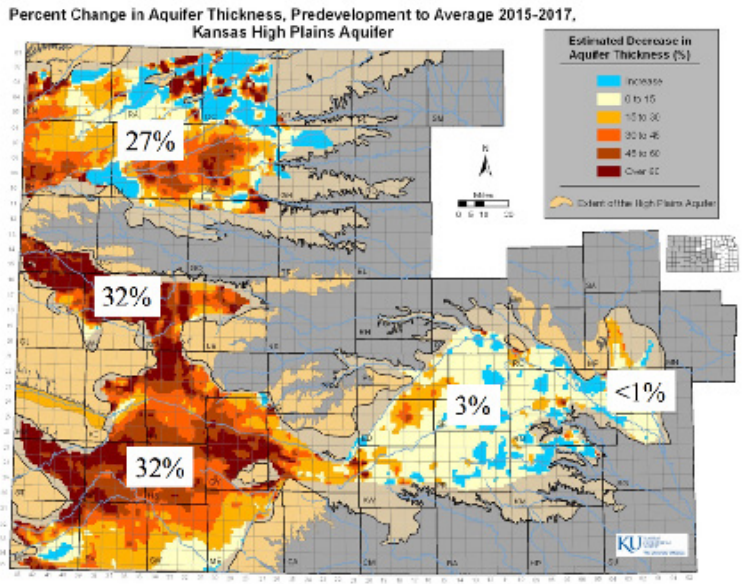


Figure 2: Amount by which Kansas's groundwater management districts would need to reduce pumping to halt aquifer level declines.
Source: Kansas Geological Survey

Jourdan Bell (Texas A&M AgriLife Extension) discussed the importance of flexibility in crop rotations and varietal selection for managing limited water supplies. In the Texas High Plains, for example, cotton production has surpassed that of corn in recent years due to advances in breeding for more productive varieties. Split pivot scenarios are also being used widely across the region to match water availability to irrigation demands, manage residues to minimize water evaporation and store soil moisture, and avoid overlapping peak water use needs. A cotton/corn combination means producers can focus water applications on cotton in early July/August while stressing their corn crop. In a grain sorghum/cotton split pivot scenario, a producer can shift water applications to the grain sorghum after cotton flowers. As well capacity becomes more limited, managing deficit irrigation dynamically becomes important rather than using a static approach to irrigation. Research has demonstrated that it's possible to eliminate early season irrigations for corn prior to canopy closure and concentrating irrigation when needed during grain fill can maximize production with limited irrigated levels. In drought years with limited well capacities, there is a clear yield benefit to using a managed deficit approach that targets the timing of irrigation levels to crop development.

Saleh Taghvaeian (Oklahoma State University) highlighted 2013 NASS Farm & Ranch irrigation survey results which show that rates of adoption of soil or plant sensor technologies by producers is very modest (~10%) even though these technologies have been around for many years. The value of demonstrating how these sensors operate and can prevent unneeded water use is important to improve adoption rates. Another area of applied research and outreach currently underway in the OK Panhandle is energy and water use audits, supported by a public-private partnership involving OSU, NRCS, and energy companies and co-ops. Farms are business operations that need to be profitable and declining groundwater levels impact pump efficiency. These audits demonstrate the positive impact of conserving water and ensuring irrigation uniformity on a producer's bottom line in terms of energy costs (~30% savings on average in electric systems) when the irrigation system and nozzles are properly maintained.

Jim Dobrowolski (USDA-NIFA) provided an overview of USDA's National Institute for Food and Agriculture (NIFA) grants, "an investment in our nation's future." NIFA is a small agency with a big budget whose funding focuses on addressing intrinsically important problems within the ag sector, improving the development and adoption of decision support tools, and increasing collaboration between local, academic, state and Federal agencies. NIFA supports interdisciplinary research and outreach related to groundbreaking discoveries in agriculture-related sciences and technologies, and effective engagement with people who can put this information into practice. One of NIFA's funding areas is support for Coordinated Agriculture Projects (CAPs): integrated, multi-disciplinary teams that focus on key ag challenge areas including climate change, food security, food safety, nutrition, and water. To maximize impact and increase coordination of research, NIFA also partners with other agencies to support research related to broad, interdisciplinary challenges such as the food-energy-water nexus.

Dave Brauer (USDA-ARS, Ogallala Aquifer Program) described the strong, multi-institutional teams supported by the Ogallala Aquifer Program (OAP) that have formed over the years, focused on economic and impact assessment, advancements in irrigation technology hardware and software, cropping systems and water use, specialty crop opportunities, and technology transfer. OAP research is led by four universities in Kansas and Texas. This high impact program, active since 2003, is funded by USDA-ARS. The program's datasets span 30-80 years of production and climate-related information that have helped push our understanding forward on how to improve water management in the Southern High Plains. The OAP's detailed evaluation of different production sectors is helping to identify valuable agribusiness models. OAP data have also been instrumental in helping support state-level shifts in policy related to regulating water withdrawals.

Daran Rudnick (University of Nebraska-Lincoln) shared recent research reviewing deficit irrigation (irrigating crops at less than full crop ET demand) of corn (see box, page 15). Deficit irrigation (sometimes called limited irrigation) is of interest to producers for a variety of reasons, including policy-related water-use allocations, limited well capacities and opportunities for water transfers. Rudnick also presented on the Testing Ag Performance Solutions program (taps.unl.edu). UNL-TAPS hosts Farm Management Competitions that evaluate production and economic decisions made by competing "farms". In 2017, 15 "farms" competed under a variable rate irrigation (VRI) system. In 2018, two competitions (corn and sorghum) are being held, both under VRI. The competitions allow producers to make a series of management decisions that are implemented on the irrigation systems, including crop insurance selection, planting density and hybrid selection, marketing strategy, irrigation scheduling and quantity, and fertilizer timing, amount, and method. The highest award is given for the most profitable farm.

During Summit workshop sessions, participants identified ways in which the Ogallala states can work together moving forward and prioritized doable actions with potential to positively impact the Ogallala region.

> *Quite honestly you need data about both soil AND plants– plants tell you when you need water and the soil info tells you how much.*
> *– Dave Brauer, USDA-ARS*

REVIEW: DEFICIT IRRIGATION MANAGEMENT OF CORN IN THE OGALLALA REGION

Synthesizing three decades of research on deficit irrigation management of corn, the Ogallala Water CAP team identified commonalities across the region and knowledge gaps that could benefit from additional research. Summary points from the article are presented below.

Corn grain yield increases with irrigation until it becomes excessive.

Deficit irrigation can have residual impacts on subsequent crops depending on the amount of off season recharge. When using deficit irrigation, the inclusion of other management practices that increase the water storage capacity of soil – maintaining residues, for example – serve as a buffer.

Appropriate crop & land management practices can reduce irrigation requirements. Soil available water can buffer between irrigation events. The timing and magnitude of water stress is critical – make sure to have water during critical time periods.

Account for inter-annual variability of crop conditions. Static management may not respond to existing conditions and can lead to unintended consequences. Be as flexible and dynamic as possible in the timing and amount of water applications.

Yield variability increases as irrigation decreases (Increased risk associated with adopting deficit irrigation).

Deficit irrigation strategies are not universal – A strategy that works for one location may not work for another; should account for climate, soil type, crop type, residue & land management, etc.

Rudnick, D., S. Irmak, C. West, I. Kisekka, T.H. Marek, J.P. Schneekloth, D. Mitchell McCallister, V. Sharma, K. Djaman, J. Aguilar, J.L. Chávez, M.E. Schipanski, D.H. Rogers, and A. Schlegel (2018). Deficit irrigation management of maize in the High Plains Aquifer region: A Review. Journal of the American Water Resources Association (accepted).

POLICY PANEL

What's Working with Policy & New Developments

The policy panel was designed to highlight how local practice and policy (supported by local, state and Federal organizations and programs) are connected and vitally important for encouraging increased water use optimization and water conservation.

Rebecca Davis (Risk Management Agency (RMA), Topeka regional office) provided an overview of the crop insurance program (CIP) run by RMA that reflects national policy on commodity production while being applicable at the county level. For situations not covered by standard CIP, RMA accepts requests for "Written Agreements". Limited irrigation crop insurance is an example of one such exception currently available for corn and soybeans in certain Kansas counties. In the counties where the limited crop insurance product is available, certain criteria apply:

A producer has to have enough water to deliver the right amount of water at the right time to produce the yields on which the agreement is written, and

The agreement needs to be written for at least 2000 irrigated acres; 30% of a producer's total acres need to be irrigated.

The coverage level provides a production coverage guarantee of ~70% relative to that for a fully irrigated crop. The limited irrigation crop insurance option offers an alternative to insurance premiums paid for non-irrigated acres. Initially, only farmers participating in the Sheridan County (KS) Local Enhanced Management Area (LEMA) were eligible for limited irrigation crop insurance coverage. Starting in 2017, RMA expanded the area for limited irrigation written agreements to include producers enrolled in a LEMA or Water Conservation Area (WCA). RMA's strong working relationship with the State of Kansas was critical for the development of the limited irrigation crop insurance product, in particular because Kansas is willing and able to provide data on water use and yields that RMA needs to run its yield estimation models. For more information on the limited irrigation CIP available through the Topeka, Kansas RMA office, please visit: https://www.rma.usda.gov/aboutrma/fields/ks_rso/.

Syed Huq (Water Resources Director, Rosebud Sioux Tribe) described how land ownership by Rosebud reservation is interspersed with privately owned (non-reservation) parcels of land in the portion of southern South Dakota overlying the Ogallala aquifer. This checkerboard pattern of land ownership introduces complexity in managing the aquifer resource under differing water rights and sustainability goals for people and the environment. The aquifer represents an important freshwater resource for the tribe, which has been actively assessing and monitoring water quality and water levels for many decades using a system of 28 monitor wells drilled on the reservation. While water levels fall during the production season, they typically bounce back with recharge over the winter.

Rod Lenz (Republican River Water Conservation District and Water Preservation Partnership) discussed the agencies and boards that work together in Northeastern Colorado, including 8 groundwater management districts (representing ~500–1000 wells/board and ~540,000 total irrigated acres. These boards have statutory authority and some interest in restricting water use ("we know we're sucking the Ogallala dry"), but lack adequate financial resources to implement and administer such programs. The Republican River Water Conservation District (RRWCD) was formed in 2004 primarily to aid the state in Republican River compact compliance. Over the last 10 years the RRWCD has played catch up to come into compliance, by retiring acres, building a $60 million pipeline, and making the serious decision to drain Bonnie Reservoir. With these measures in place, focus can now shift to what can be done to increase water conservation, with leadership provided by the Water Preservation Partnership (WPP). The WPP, made up of representatives from each district, aims to ensure local design and control of conservation measures.

In 2014, the WPP partnered with CSU to evaluate the potential economic impact and viability of pumping reductions (for example, of 25% compared to current use levels). While the results of the WPP's proposal to consider the effects of a 25% pumping reduction were a bit shocking, the analysis provoked substantive, valuable conversation.

INSIGHTS FROM PARTICIPATING IN COLORADO'S WATER PRESERVATION PARTERNSHIP

During his presentation, Rod shared the following takeaway based on his experience working with the WPP.

Decisions need to be made and administered locally so that others (state and Federal entities) don't intervene. That said, having some kind of "traffic cop" helps to organize and focus the efforts of different groups on conservation.

Local boards need to be empowered, educated and motivated to exercise the powers they have to govern water management. Time is of the essence; we need more recruits to help do this work of extending the life of the aquifer.

Don't get discouraged, stay positive! Blame doesn't forward anyone's agenda. We are making progress even if it's slow on getting people to think about and work on conservation. This shift is encouraging: conversations a decade ago on water were often typically arbitrated by lawyers.

Stay flexible with your road map for conservation. Opportunities may present themselves that take you in a different direction.

People often want tech to be the main driver behind conservation but it doesn't always work out that way. Sometimes, restrictions are necessary to encourage those slower to adopt a new technology or engage in more conservation and/or more water use-efficient practices.

Steve Walthour (General Manager, North Plains Groundwater Conservation District, NPGCD) provided an overview of NPGCD activities since 2009 in response to region-wide water planning goals in the Texas Panhandle that imposed water use reductions down from 24 acre-inches/year to 18 acre-inches/year. For example, farmers on the NPGCD board of directors developed a competition in which participants were challenged to produce 200 bushels of corn on 12 inches of applied water. The district also started organizing on-farm demonstrations by farmers for farmers of different water management tools and strategies. After a 5 year program focused on education about soil moisture probes, the district decided to invest in having a demonstration field where they could test the outcomes of using different amounts of water and crop varieties, better understand the role of soil in water management, and share both results. Since 2015, the district has run its Master Irrigator program, a 24-hour in-depth water management education course taught by producers, dynamic researchers and Extension educators and others, which covers a comprehensive water management curriculum (see blue box below).

MASTER IRRIGATOR PROGRAM

For producers to make shifts in their water management, conservation practices and tools have to pencil out and make sense for their operation. The four-day Master Irrigator program run by North Plains Groundwater Conservation District (NPGCD) covers an extensive range of topics, including:

- How to measure and interpret crop water use and soil moisture data
- Strategic irrigation management and the economics of irrigation scheduling
- System application efficiency and track management
- Pros and cons of variable rate irrigation and variable frequency drive systems, LEPA and SSD systems
- Remote monitoring (including satellites and drones)
- Explanation of tools including the crop profitability analyzer
- Soil health
- Seeding rates
- Pros and cons of pre-watering and more

NRCS cost-share funding is available for eligible producers who complete the Master Irrigator program. For some participants not eligible for cost-share dollars the knowledge gained during the program has been the incentive motivating their enrollment.

> *This idea that 'conservation costs' will never sell or lead to widespread adoption if it doesn't help producers with their farming and bottom line.*
> *– Steve Walthour, North Plains Groundwater Conservation District*

Ray Luhman (Manager, Northwest Kansas Groundwater Management District 4) described how the Groundwater Management District (GMD) 4 Board has leveraged capacity granted through Kansas state statutes to successfully implement two Local Enhanced Management Areas (LEMAs). The "Sheridan 6" LEMA, which completed its first 5-year period of authorization in 2017, was re-instituted for another five-year period (2018–2023). In the spring of 2018, a second, "district-wide" LEMA was established whose guidelines span varying levels of water level declines and varying levels of restriction.

While these two LEMAs use the same set of state required protocols, it was producers who set the Sheridan 6 LEMA's goals with the GMD board. Sheridan 6 LEMA involves 99 sections and fewer than 200 wells, with producers committing to restricting their water use to 55 acre-inches over 5 years. The development of the district-wide LEMA plan was initiated and led by the GMD4 staff and board. The district LEMAs are currently impacting ~2,190 wells or groups of wells and ~327,000 acres. While the district's efforts with LEMAs have encountered resistance from some people in the district, they have also effectively encouraged shifts in water management and in-depth conversations about conservation. Another powerful tool available in Kansas is Water Conservation Areas, in which irrigators (an individual or a group) make a commitment with the state to voluntarily conserve water in exchange for some flexibility in how they use their water rights, for example, allowing movement of allocations between enrolled rights, multi-year allocations, or allowing new water uses.

Table groups identified current opportunities and barriers to achieving greater water conservation and water use efficiency and specific actions to which they could commit in the coming year related to addressing Ogallala region water-related challenges.

CONCLUSIONS

There is no one size fits all solution—there are many different actions water users can take to benefit themselves, the aquifer, and the region, whether a landowner or land user is sitting on 400 feet or 75 feet of saturated thickness. Water management in the region has and will always be evolving and improving. Today, with the range of technologies and (near) real-time data available, farmers are more able than ever to determine if, how, and when they can avoid using a few inches of water each year that won't benefit their crops, extending the value potentially derived from that water's use further into the future.

Continuous regional and cross-state collaboration can benefit the Ogallala region. Examples of such collaboration include:

- Expansion and/or replication of successful programs and ideas
- Wider dissemination of research findings, the impacts of water management tools and strategies on producers' bottom lines and/or the aquifer
- Cooperation on program development aimed at increasing the adoption of successful water management methods, including helping make sense of the effectiveness and potential cost-savings (time, water, and money) of water management technologies
- Leveraging support for water management education and incentive programs for farmers
- Joining forces across state lines, institutions, disciplines to seek targeted research funding

Just 10 years ago, too many states were still embroiled in lawsuits against each other instead of working together; this pattern has given way to a new trend in which there are many engaged actors (farmers, researchers, educators, tech company leaders, policy makers, commodity leaders and others) motivated to learn from and benefit from working together, even if ultimately the decisions are made at the individual or local level. The range of solutions and motivation to take action are all part of the common outlook, described at the Summit as "having an aquifer engaged identity."

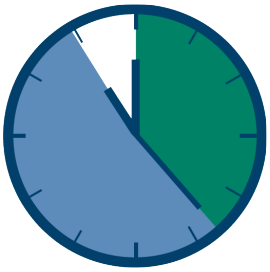
The region is at an interesting crossroads in time. Declines in water quantity and quality, fluctuating markets, and climate change impacts create uncertainty and risk for producers in the region. Meanwhile, our capacity to monitor and manage water in crop and livestock systems in order to reduce risk and increase resiliency is advancing rapidly. Innovative management at the farm level combined with innovative policies to support water optimizing and water conserving practices can make a difference in extending the productive life of the Ogallala aquifer and sustaining profitable agriculture and the region's ag-dependent communities.

> ***Our hope is for everyone to be able to learn from each other and save water. Advances in tech and management are creating new opportunities for conservation. We hope to find ways to incentivize water savings while maintaining yields and profits for future farmers.***
> ***– Summit participant***

Ogallala Aquifer Summit

Participant Evaluations

A constructive use of time

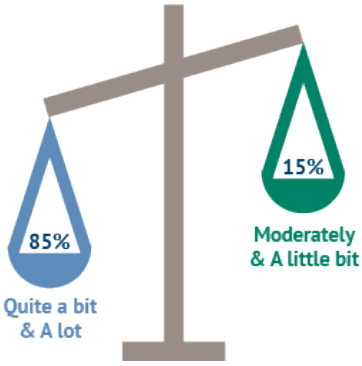


Quite a bit = **52%**
A lot = **42%**
Moderately = **5%**
A little bit = **1%**

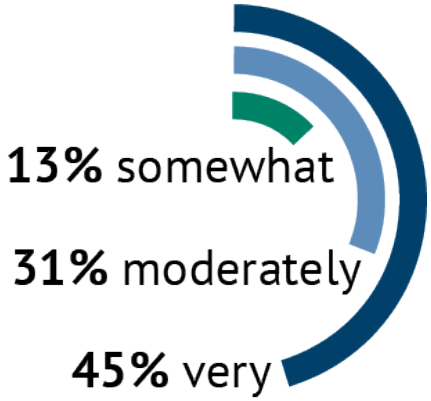
Established new connections that will be useful in the future

Quite a bit = **44%**
A lot = **32%**
Moderately = **19%**
A little bit = **5%**

Produced useful ideas for shifting groundwater management

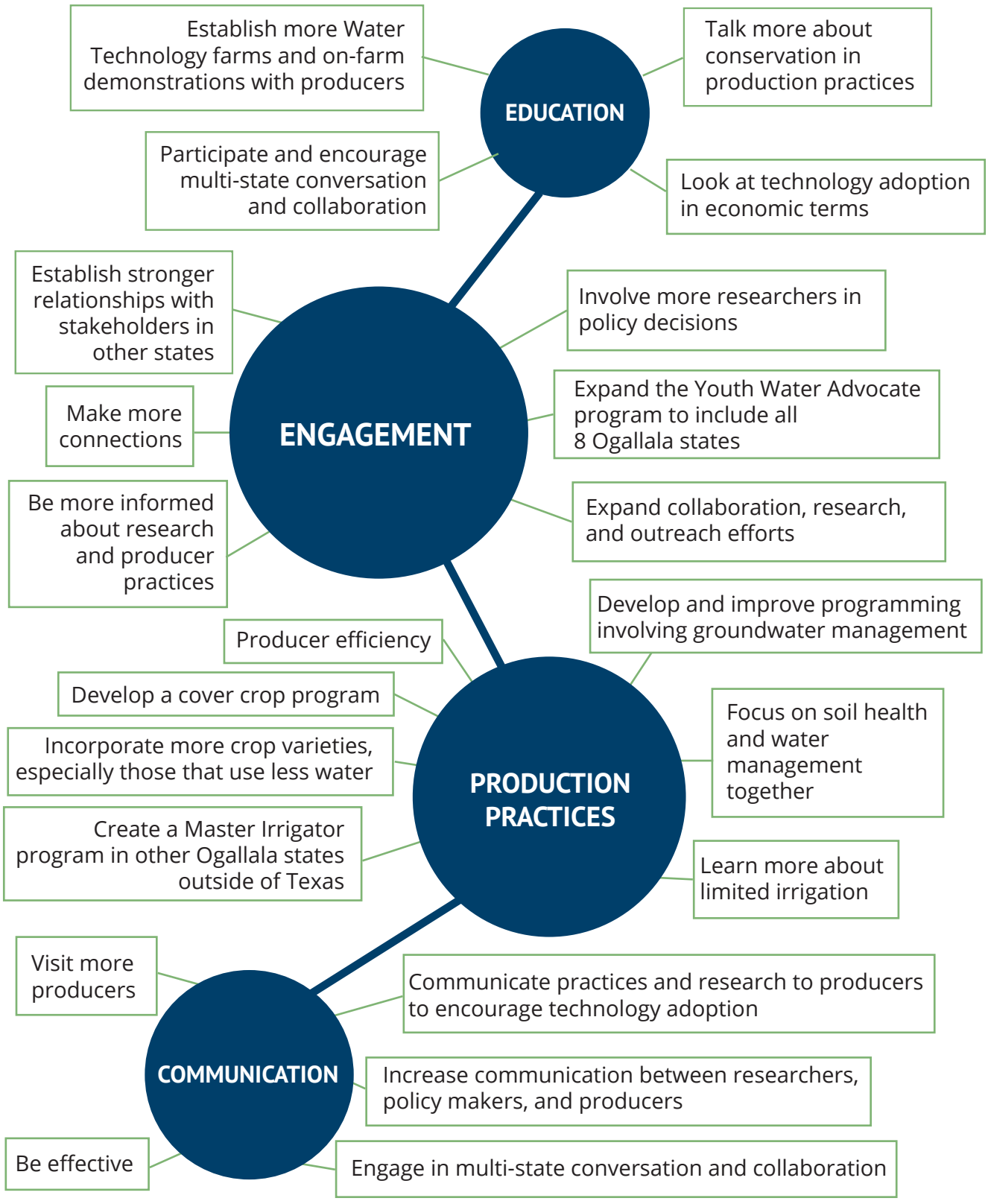


Based on what they heard and learned at the Summit, how likely were participants to make a change in their work...



See the next page for a summary of changes Summit participants said they would make.

Likely Changes Attendees Will Make After the Summit



THANK YOU TO OUR PARTNERS!

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