Kristiana Hansen
University of Wyoming, Agricultural and Applied Economics Department and University of Wyoming Extension

Windy Kelley
University of Wyoming Extension, USDA Northern Plains Climate Hub

Rebecca Witinok-Huber
University of Wyoming, Haub School of Environment and Natural Resources

Juliet Daniels
University of Wyoming Extension, Community Vitality & Health, Laramie County

Micah Most
University of Wyoming Extension, Agriculture and Natural Resources, Johnson County

Emily Peters
University of Wyoming, Agricultural and Applied Economics Department

WYOMING AGRICULTURAL TECHNICAL SERVICE PROVIDER WEATHER, CLIMATE, AND WATER NEEDS ASSESSMENT

University of Wyoming | College of Agriculture, Life Sciences and Natural Resources

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Kristiana Hansen
University of Wyoming, Agricultural and Applied Economics Department and University of Wyoming Extension. Corresponding author, kristi.hansen@uwyo.edu, (307) 766-3598

Windy Kelley
University of Wyoming Extension, USDA Northern Plains Climate Hub

Rebecca Witinok-Huber
University of Wyoming, Haub School of Environment and Natural Resources

Juliet Daniels
University of Wyoming Extension, Community Vitality & Health, Laramie County

Micah Most
University of Wyoming Extension, Agriculture and Natural Resources, Johnson County

Emily Peters
University of Wyoming, Agricultural and Applied Economics Department

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Editor: Brooke Ortel, University of Wyoming Extension
Designer: Jeremy Cain, University of Wyoming Extension

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ABSTRACT

Agricultural producers and their local technical service providers (TSPs) need timely, science-based, and region-specific information and tools to enable them to make climate-informed decisions about their operations. This bulletin reports the results of six focus groups of TSPs serving the Wyoming agricultural community to better understand their knowledge, skills, and resource needs around changes in weather and climate variability and water availability.

INTRODUCTION

Temperaures have been increasing in Wyoming relative to historical averages, and extreme weather events (such as droughts, floods, and wildfires) are becoming more frequent and severe (Frankson and Kunkel 2022, NCEI 2024). The semi-arid climate and prevailing rangeland and cropping systems of Wyoming place producers and their rural communities at significant exposure to weather and climate variability. Agricultural producers, their communities, and the local technical service providers (TSPs) who serve them need timely, science-based, and region-specific tools and information to make climate-informed decisions about their operations.

However, the right tools and information do not always exist. If tools do exist, they may have been developed for other places and agricultural systems and therefore might not be well-adapted to this region. As local TSPs are confronted with new weather, climate, and water availability situations in their communities, they also may not know where to find tools and information.

The purpose of this extension bulletin is to summarize the findings of six focus groups of Wyoming agricultural TSPs on the topics of weather and climate variability and water availability. The bulletin describes the weather-, climate-, and water-related challenges that TSPs currently face in their jobs. It describes the knowledge, skills, and resources they feel they lack that would enable them to do their jobs more effectively. One clear theme from these focus groups is that some TSPs are extremely knowledgeable about weather- and climate-related issues because of their training, educational background, or experience. Many of these TSPs already undertake educational programs, technical assistance, data collection, tool development, research, and data communication—both formally and informally—to help Wyoming agricultural communities. (See Appendix B at the end of the bulletin for a list of activities that some TSPs report already doing.) Another clear theme, however, is that other TSPs do feel the need for additional tools, training, and peer assistance. This bulletin lays out some of the needs identified by Wyoming agricultural TSPs.

Technical service providers (TSPs) serving the agricultural community include employees of UW Extension, conservation districts, private consulting firms, USDA NRCS and FSA, and state/federal land management agencies, among others.

This bulletin could be useful for several different audiences. First, agricultural TSPs in Wyoming wanting to increase their weather, climate, and water knowledge can learn from their colleagues who participated in the focus groups. Second, leadership and other decision-makers within TSP organizations or conservation non-governmental organizations (NGOs) may identify opportunities to integrate weather- and climate-related programming into continuing education training for their employees or affiliates. TSP organizations or conservation NGOs may also gain ideas from these results on how to prioritize resources. Third, these focus groups will inform follow-up work undertaken by the University of Wyoming Extension.

METHOD AND APPROACH

We completed six focus group discussions with agricultural TSPs in Wyoming from June 2023 through May 2024. The 49 participants included representatives from local, state, and federal government agencies, non-profits, municipal services, and the University of Wyoming, with an average of eight attendees per group. The discussions, facilitated by a UW Extension educator, followed a scripted format with eight questions. (See Appendix A for full script.) Five groups met in person; the final group met virtually due to adverse weather. Participation was voluntary, and lunch was provided.

Focus groups were audio-recorded and transcribed using Otter.ai (Otter.ai 2024). Follow-up discussions were captured on sticky notes (Figure 1) and later transcribed into a data spreadsheet alongside the audio transcripts. Results were then analyzed with Dedoose (Dedoose Version 9.2.7 2024), with formal analysis findings reported in Witinok-Huber et al. (2024). This study reflects the voices of the 49 TSPs who participated in the focus groups. One limitation of the study is that our sample reflects the relationships and contacts of our team (which comprised UW Extension personnel and social scientists) and so may not be representative of all TSPs serving the agricultural community in Wyoming.

TSP responses to the scripted focus group questions are summarized below in sections 3 to 8.

CHALLENGES: WEATHER, CLIMATE, AND WATER AVAILABILITY

Focus group participants were asked, "What do you see as the most important weather, climate, and/or water topics for the Wyoming agricultural community in the future?" Drought was by far the most mentioned weather- and climate-related concern, with many noting the impacts of drought on rangelands and forage supply. Many responses to this question were also about changes in weather and climate. Changes in rain versus snow were noted, as well as a shift from cold winter snowpacks to late winter/spring rainfall. Several focus groups also noted receding glaciers and more extreme weather events, such as longer and more severe winters, increased flooding, and fire (due to increased annual grass presence).

Participants also noted changes to the agricultural growing season and related irrigation challenges, as well as changes in the amount and timing of water availability for irrigation. Several participants expressed concern about aging infrastructure and the need for more well maintenance. Many participants were concerned about water storage. Some participants suggested the need for increased focus on soil health so that soil could be used as a sponge to retain moisture and reduce damage from flooding events. Other participants suggested a need for more reservoir storage.

Figure 1. Example of the focus group sticky board used to compile and discuss question topics.

Table 1. Data needs

Raw data needs
- Weather stations
- Stream gauges
- Soil moisture probes

Example tools and app needs
- Tools (for example, a wind chill app) to help USDA FSA employees make eligibility determinations for federal insurance programs
- Updates to the current red flag wildfire warning system that combine soil moisture content and other real-time indicators

Forecasting needs
- Improved streamflow, soil moisture, and flood prediction forecasting in the springtime
- 3- to 6-month outlooks for precipitation conditions to help with cropping decisions
- Within-season forecasts to help producers anticipate whether cover crops might be successful that year
- Grass availability predictions for rangelands and grazing management

Data hub needs
- Central "one-stop-shop" hub where producers and TSPs can access raw weather, climate, and water availability data
- User-friendly data packaged for easy access
- Data compiled and developed into tools and apps so that producers can use it in management and decision-making

Competition for water between sectors of the economy is also a challenge. Water challenges in the Colorado River Basin were referenced by multiple focus groups (not just the focus group held in southwestern Wyoming), but so were more local concerns elsewhere in the state about water moving out of agriculture. One participant noted the challenge of navigating outdated federal land management agency policies that do not allow for flexibility by producers who are trying to adapt to changes in season length and timing of precipitation. Another noted the challenge of policies and guidelines changing when there is a change in federal administrations and associated priorities. Several participants noted that being aware of changing regulations and policies presents a challenge for both TSPs and their clients.

DATA NEEDS

Several questions asked focus group participants about data needs. Participants' responses fell into four categories: 1) raw data, 2) tools and apps to translate raw data into information that producers can use in decision-making, 3) forecasting, and 4) data repository needs. Each of these categories is discussed below (and in Table 1).

Raw Data. Some participants expressed a preference for raw data over model output. They noted that producers often trust raw data because a rain or temperature gauge provides information directly, whereas models can be a "black box" whose process of turning inputs into outputs is not always well understood. A related point is that producers are often less interested in conditions across the entire landscape and more interested in what is happening to them directly, in their specific location. One range conservationist noted that it can be challenging to use broad, aggregated data to analyze conditions on a particular allotment.

Every focus group discussion emphasized the need for more weather stations, noting that the existing weather station network doesn't adequately capture the spatial variability in soil moisture and climate in Wyoming. Several participants shared anecdotal evidence of TSPs and producers relying on the closest weather station—which was located in a place that received greater rainfall.

Participants in three focus groups also noted a specific need for more weather stations at lower elevations, because a high snowpack event coupled with significant runoff could lead to the snowpack not being useful at lower elevations or, even worse, increasing flood risk. At lower elevations, it can also be challenging to determine how much snow is physically present during a winter storm event. For this reason, accumulated snow inches at lower elevations can be just as important as moisture accumulation at higher elevations. It would be useful if precipitation models were better able to capture more of these risks.

While most data needs discussion centered on the need for more weather stations, most focus groups also raised the need for more stream gauges and soil moisture probes to collect more useful precipitation information. One participant noted that it is important to get community members involved in siting weather stations so that they are located in useful places and so that community members are invested in the project.

One focus group also discussed the importance of data credibility. Data should be third-party verifiable when possible. For example, if the rain gauge at a producer's place could be transmitted automatically to a third-party, this would help to assure program managers (such as USDA Farm Service Agency [FSA]) that no tampering had occurred.

Tools and Apps. Although some participants expressed a preference for raw data, all focus groups also discussed the need for tools and apps to turn raw data into information that can be used in producer decision-making. One notable example was an app that would help USDA FSA employees more easily make eligibility determinations for federal insurance programs (for example, a wind chill calculator). Another example was updating the current red flag wildfire warning system, as overlaying soil moisture content with other real-time indicators would be helpful for fire preparation. Some participants also noted that good tools often already exist but can be difficult to access, use, or interpret. Other participants reported that there are already several new and useful resources and apps available (for example, the NRCS tool Multiple Indicator Monitoring [MIM], onX, and Windy.com), but that they are not always well-publicized.

Forecasting. A common theme across focus groups was the need for improved forecasting capability. (Several focus groups joked that a crystal ball would be especially helpful.) Specifically, multiple participants mentioned the need for improved streamflow, soil moisture, and flood prediction forecasting in the springtime. Most of the forecasting needs mentioned related to 3- to 6-month outlooks for precipitation conditions, to help with cropping decisions. For example, if it was going to be wetter, producers would know to plant more seed. If it was going to be drier, they would know to adjust their fertilizer application. More specifically, one group wanted better within-season forecasts to help producers anticipate whether cover crops might be successful that year, whether for fall or spring planting. Several focus groups also discussed the need for better grass availability predictions for rangelands and grazing management. (Grass-Cast provides such predictions for rangelands in the eastern portion of the state. Participants expressed an interest in extending Grass-Cast to shrublands and forest allotments farther west.) One focus group participant noted that artificial intelligence may be useful for making forecasts in the future.

Data Repository Needs. All six focus groups expressed a need for a central hub to house existing data. They observed that there is a tremendous amount of raw weather and climate data available on the internet. However, it can be overwhelming to determine where to go with a specific data question. The different focus groups described this data hub as a "one-stop shop" or resource database specific to Wyoming, where people could go with questions related to weather and climate. Some participants expressed an interest in being able to access raw data at the data hub in a user-friendly fashion. Others expressed interest in modeled output, organized and ready for use in management and decision-making. One TSP noted that once a person knows where to go, even then, some of the existing websites are not particularly user-friendly. A central data hub website would make information easier to access.

HUMAN CAPITAL DEVELOPMENT AND RESOURCE NEEDS

Participants were asked what additional knowledge, skills, and resources would be helpful to them in meeting job demands related to climate science. Several participants noted that extreme weather events, as well as sudden changes in federal or state agency policies, create a changing landscape of what TSPs need to know, which can make identifying outstanding needs challenging. As one participant put it, "I don't know what I don't know." Another participant suggested that TSPs probably do have enough information because the public are not asking enough questions. Other participants across focus groups, however, were aware of their knowledge, skill, and resource needs. Top weather-, climate-, and water-related human capital and resource needs raised by TSPs are listed in Table 2.

Trainings. Participants in all focus groups expressed an interest in additional training opportunities directed toward increasing their skills and knowledge (Table 2). Regardless of preferred modality—participants expressed interest in synchronous webinars, asynchronous web-based trainings, and in-person regional meetings—most participants emphasized the importance of being able to ask presenters follow-up questions and to engage with them on the material. Participants also emphasized the importance of networking opportunities with TSPs from other agencies with similar job responsibilities, to learn how they are dealing with some of the same challenges. One participant also indicated an interest in regional meetings as an opportunity to learn what researchers and TSPs in other places are doing to be more effective at serving their clients.

Table 2. Training topics of interest

Basic weather and climate knowledge	- Weather/climate terminology. - Understanding the basic carbon cycle.
Finding data	- Finding weather/climate data.
Data interpretation and analysis	- How to interpret data, e.g., when to look at temperature averages versus daily minimums and maximums.
Projection interpretation	- Understanding predictive models and interpreting the validity of different climate projections.
Climate communication	- Talking about climate change with Wyoming producers. Encouraging producers to adopt practices that might improve their operation and have a positive impact on climate change.
Use of existing decision support tools	- Understanding tools that are already out there. - Knowledge of what resources other TSPs find useful.
Technology	- Modeling to be better able to describe current conditions. - GIS skills. - Using "*R for Data Science*" to visually represent data for themselves and their clients. - Integrating data into usable information. For example, ArcGIS and story-mapping skills at a conservation district would help provide a compelling story for why producers might want to implement certain federal programs.
Understanding climate change mitigation	Understanding climate change and what can be done to slow it down.

Training in climate communication was a theme that arose repeatedly, as participants grappled with how to address changes in weather and climate variability without being perceived as raising a controversial topic. As one participant noted:

> "…There's so much distrust and politics involved in climate that if you say climate, producers say, nope, I'm out. But this is on-the-ground stuff that producers need to know."

Another participant shared that it is difficult to explain climate change, and even using the term can turn people away or ignite controversy. They noted:

> "Not everybody's on board with the concept and then trying to explain climate change in a way that doesn't become heated is a challenge, or we lose their interest. We're voluntary so we really need them on board with us."

Yet another participant suggested that training and practice in discussing controversial topics could be useful, further saying:

> "I wish more of us felt confident and comfortable enough to just have some of those simple conversations about weather and climate, so that when producers bring something up about weather and climate, TSPs feel confident enough to continue that conversation and see where it goes."

Peer-to-Peer Learning Community. The idea of networking and learning from each other came up repeatedly during the focus groups. Participants expressed interest in the development of a peer-to-peer learning community. For example, a brownbag webinar series could serve as a way to get questions answered, build community with other local experts, and share experiences, information, and resources. Another option might be a message board, a place where people could respond to questions that other people post.

From time to time during the focus groups, a question raised by one participant was answered on the spot by another participant, demonstrating that the focus groups were themselves a form of peer-to-peer learning within the TSP community. Participants in two focus groups suggested a need for a central place where TSPs could post or drop off questions for UW researchers.

Additional Funding and People Power. TSPs are experiencing workforce shortages and pressures from changing job demands, whether due to changes in federal policies and regulations or

Table 3. Shortages in personnel and other resources

- Shortage of conservation district program specialists to move money and resources to the producers who need it.
- Shortage of USDA FSA representatives.
- Shortage of USDA NRCS engineers to perform studies needed to implement infrastructure improvements.
- Shortage of firefighting personnel and staffing for fire departments.
- Shortage of funding and personnel to help homeowners reduce fuel.
- Shortage of funding and personnel needed for weather station maintenance. One participant provided an example of a weather station that is not functional because the person who managed it left their position and has not been replaced.
- Shortage in existing budgets to cover both proactive work before disasters occur (e.g., repair and maintain dams and build berms) and mitigation work post-disaster.

in response to increased incidence of extreme weather events. For example, one participant noted that "change takes people resources."

Another participant noted,

> "Producers don't have enough time to follow through, to find the information, to make use of the information, to plan ahead, to implement those plans. What they want is one-on-one help from TSPs in doing those things, like sit down at the table with producers and work through their unique situation. And we just don't have enough capacity to do that."

In addition to these shortages in TSPs who deal directly with agricultural producers, participants identified shortages in personnel to deal directly with managing the landscape in response to changes in weather and climate variability. One notable example came from the perspective of managing wildfires:

> "Staffing for fire departments is problematic, and especially seasonal staffing. And now that shoulder seasons are extending out, we're understaffed and unable to meet demand throughout the year…it's just a local, state, and national problem…."

Table 3 lists other examples of employee shortages raised by TSPs.

RESEARCH NEEDS

Focus group participants were also asked what additional research and research outputs would help make their jobs easier. Discussion in several focus groups centered around the need for more research that is locally conducted and relevant. We need researchers to be on the ground working with producers, one participant noted. Landowner and producer involvement in research is important, noted another participant, because they see what is needed. Several participants noted the importance of demonstration farms and on-farm research as well as additional proactive research at UW research and extension centers.

Participants described many weather/climate variability and water availability research needs in a variety of areas. Table 4 presents specific examples.

One theme among participant comments was the need to prioritize research with management implications for agricultural producers. Most participant comments focused on physical and biological science research needs, reflecting focus group composition, though some participants also commented on the need for more research involving economic management tradeoffs. One participant highlighted the multiple time scales at play when thinking about managing for and adapting to weather and climate variability:

> "…If we are using these [climate] models and if we are assuming they are accurate, it would be good to know what things producers may want to adapt in their operations in the next 10 years and 5 years...It's very easy to change what you plant. If you can find the markets, you just plant something different next year. It's maybe more difficult to change your breeding schedule, your spring and fall calving, and your turnout schedule. And changing how you use your allotment would be an even more complex multi-year process."

It is worth noting that research already exists or is currently underway on many of these topics. In these instances, the outstanding challenge is to make this research available to producers, TSPs, and practitioners.

Table 4. Examples of weather/climate and water availability research needs

Research needs related to agricultural production
- Identification/development of cover crops that can improve the soil (add/retain nutrients, reduce soil erosion) even with reduced irrigation and/or precipitation.
- Development of new tools for wheat-fallow farmers in eastern Wyoming to avoid erosion.
- Understanding how farming practices affect soil (both moisture and health).
- Understanding how to make farming practices more resilient to changes in weather and climate variability.
- Irrigation methods, including impacts of change in irrigation technology (e.g., transition from flood to pivot) on hydrology (e.g., groundwater aquifer levels, future water availability), wetlands, and wildlife.
- Changes in groundwater and surface water interactions.
- Improving consumptive use calculations (needed by, for example, the State Engineer's Office during proceedings to change water rights).
- Impacts of new wells and fracking on water supplies.
- Understanding how frequently extreme weather events may occur in the future. Producers may have money for one contingency in one year but struggle when they are hit with another event in the following year.

Research needs related to rangeland management
- Modeling to describe what is happening on the rangeland landscape (e.g., shifts in plant composition due to long-term drought) and to suggest solution paths.
- Research into how the presence of invasive plant species is going to change under altered climate conditions.
- Development of more low-tech methods for landscape restoration after fire or other disturbances.
- Understanding shifts in plant communities under altered climate conditions.
- Updated Ecological Site Descriptions,[1] to reflect climate change.
- Completion of the USDA soil survey.

Research needs related to forest management
- Understanding how forestry management will need to adjust in order to respond to climate impacts.
- Research into the current and projected vegetation transitions in forests. For example, ponderosa pine has been observed growing in places that it has not grown in the past.
- Understanding how bark beetles or other insect infestations affect forests and how forest management should respond.

Research needs with a social and economics focus
- Understanding of how weather/climate variability affects the financial/economic bottom line. (For example, how does weather elsewhere affect agricultural input prices such as the cost of insurance, feed, and transportation?)
- Research into the current and future economic impacts of climate change on the agricultural sector.
- Research into how new practices to increase resiliency could affect the economics of an agricultural operation. (For example, many producers could manage risk by adding yearlings to their cow-calf operation so that they could cull yearlings in dry years instead of their genetic stock. When is this an economically viable option?)
- Understanding how/when technical alternatives to current agricultural practices could be helpful. (How/when is precision agriculture economically viable? Should Wyoming producers and residents be doing more indoor agriculture?)
- Research that correlates behavioral change to dollars saved or similar metrics that are important to producers. Education to landowners or agricultural operations on impacts of different courses of action to the bottom line, in the short term.
- Research into whether/how agricultural producers should change their operations in response to changes in weather/climate variability.

1 Ecological Site Descriptions (ESDs) classify range and forest land based on site characteristics (physiographic, climate, soil, and water features) and plant communities (plant species, vegetation states, and ecological dynamics). The USDA's Natural Resources Conservation Service (NRCS) has led the effort to create ESDs. NRCS, the U.S. Forest Service, and the Bureau of Land Management all use ESDs to cooperatively identify and describe ecological sites to inventory, monitor, evaluate, and manage range and forest lands.

RESEARCH TRANSLATION NEEDS

Participants in two focus groups noted that there is no point in conducting research that does not reach the hands of people who can use it. As one participant noted, "There's a lot of research out there. But if we can't get it to the people that are doing the work, it's useless." Another participant similarly noted: "What's the point of having information, if you can't get that information to the people who need it?"

As the focus groups pointed out, once research is conducted, it should be translated into management tools that are useful in producer decision-making. One participant also suggested that researchers need to be more involved in getting proven research into the community. Some focus group participants also emphasized the value of having UW researchers present at regional UW Extension events because it makes research translation more effective and helps researchers better understand local research needs. A participant in a different focus group noted that researcher presence at regional UW Extension events also encourages sustained engagement and builds trust between researchers and landowners/producers. Table 5 lists several examples of weather/climate and water availability research translation needs mentioned in the focus groups.

COMMUNITY RESILIENCE NEEDS

In the context of these TSP focus groups, community resilience is the ability to anticipate, prepare for, and respond to weather-, climate-, and water-related events, trends, and disturbances. Community could mean geographic communities of people living together in the same town or region. It could also mean the Wyoming agricultural community as a whole, bound together by profession/industry and a shared exposure to weather and climate variability.

The final focus group question asked participants to think about the best next steps to building community resilience among their clientele, whether through research-related activities, useful and usable educational products, or collective community efforts to increase awareness, preparedness, and response.

Education. Participants had many suggestions for educational programming that would benefit their clientele. Table 6 lists specific examples.

Building Relationships. Participants in all six focus groups discussed building relationships and trust with their clientele as important to dealing with increased weather, climate, and water challenges. One participant noted that TSPs who specialize in producer education need to focus on building and maintaining relationships with their clients and other TSPs, not on adopting new computer apps. Relationships that are sustained over the long run through repeated positive interactions allow trust to build. This can make it easier to have conversations on potentially

Table 5. Examples of weather/climate and water availability research translation needs

- Accessible explanations of existing data. For example, temperature and precipitation data are generally considered in 30-year time frames. With climate change, it would be useful to also demonstrate how trends are changing.
- Weather/climate research packaged in a way that would help TSPs (especially conservation districts and local NRCS reps) justify grant proposals to, for example, Federal Emergency Management Agency or Inflation Reduction Act funding opportunities.
- More accurate plant production tables (needed for FSA determinations on drought severity and impact on crops).
- Information on irrigation (for example, evapotranspiration rates and how much to irrigate).

Table 6. Examples of weather/climate and water availability educational programming needs

- Additional education for people with small acreages on their rights and responsibilities regarding their water rights.
- Demonstration projects and information/education about alternative practices that would improve agricultural resilience.
- Education for farmers to help them understand how water availability challenges will affect them.
- Education for water rights holders on Wyoming water law, how much water to use, application rates, and how to address aging water infrastructure.
- Outreach products/materials on available FSA insurance and emergency assistance programs for crops and livestock.
- More awareness within the community on how water availability is affected by forests.
- Education about climate change, drought, and flooding.
- Information on what documentation is needed to apply for emergency assistance/loan programs and crop and livestock insurance programs.
- Information on what can/should producers do versus not do with water resources, given current water conditions.
- Water use comparison between grass lawn versus rocks/native landscaping.
- Guidance on flood preparation.
- Costs of ripping out sod and replacing it with rocks/native landscaping.
- University of Nebraska-Lincoln has evapotranspiration estimates readily available for lawns, so that people can learn what the right amount of water is to apply. Can the same things be done for Wyoming?

controversial topics like weather and climate variability and water availability. One participant explained that fostering conversations about climate change without existing relationships is very difficult. A participant in a different focus group suggested that rather than using the phrase climate change, which is political and controversial, weather and climate information should be more directly described as on-the-ground knowledge that producers need to know in order to manage land and water resources well. Another participant noted that it is not necessary to talk about why the climate is changing in order to have good conversations about being resilient to changes in climate.

Several focus groups also highlighted the difficulty of building relationships with hard-to-reach clientele. Participants in two separate focus groups noted that it can be easy to fall into the trap of talking with the same producers over and over, but that drawing in and building relationships with new clientele is key. One participant suggested building community through peer-to-peer learning among producers, noting that this can often be more effective than hearing from a range conservationist or forester employed by a federal agency. Another participant in the same focus group noted that one early adopter, if they are a well-respected producer, can be enough to bring about a noticeable increase in adoption within a community. Finding ways to encourage peer learning is important.

Two focus groups also discussed the importance of building partnerships between local, state, and federal agencies serving the agricultural community. TSPs generally have similar objectives, whether they serve producers through education, technical expertise, or funding support. However, some TSPs may be better positioned to assist in certain contexts than others, some participants observed, because some agencies specialize in collecting data while others focus on analyzing data. Additionally, when one agency might not be trusted in one context, colleagues from other agencies could step in to provide assistance. Increased communication, data sharing, and information transfer between agencies would be useful.

One focus group discussed the importance of supporting early-career TSPs so that they become effective TSPs, maintain strong job satisfaction, and remain in Wyoming. This was a call for more seasoned TSPs to value the innovation that early-career TSPs can bring to their jobs, and to find ways to mentor them.

Individual and Community Actions. Several focus groups emphasized the importance of translating data into information that is useful in producer decision-making. On the one hand, this was a call to individual action. As one participant noted, individual producers need to act when action is needed. For example, if a producer needs to build a berm, then they need to build it rather than just thinking about it. As another participant noted, we in Wyoming are at the top of several watersheds with water supply challenges downstream, yet we still have lawns; perhaps we need to lead by example, they noted, and replace lawns with more drought-tolerant landscaping.

On the other hand, this was also a call for community action. One participant noted that a more community-oriented mindset would be helpful. Another noted the need for empathy in understanding the interconnectedness of water resources across the region. Yet another participant calling for increased empathy noted the need for more conversations between agricultural and non-agricultural water users in water-tight regions, such as the Colorado River Basin. As one participant asked,

"What do we do when we don't have enough water? What is acceptable yield and quality? In both the agricultural and non-agricultural contexts, instead of thinking about what is optimal, maybe we should be thinking about what is acceptable."

Another participant highlighted the importance of having community discussions about how to prioritize resources and species when difficult choices must be made.

Participants in three of six focus groups discussed the need to find the positive in changes to weather and climate variability. Agricultural resilience is found through supporting local economies, whether it be the local sale barn or a local processing facility, one participant noted. Another participant observed that with change can come new opportunities, such as local markets for beef and realizing new activities to support industry and economic development. Yet another participant suggested that TSPs need to change the tone of discussions around climate toward a focus on instilling hope. A fourth participant noted that producers and TSPs are resource managers who, through thoughtful and deliberate management, can improve resource conditions. We need to find and share examples of successful and effective resource management, they noted.

CONCLUSIONS

One clear theme from the focus groups is that Wyoming TSPs and researchers are already doing a lot to address weather/climate variability and water availability challenges in Wyoming. Some TSPs regularly find the information they need to navigate these challenges effectively. However, other TSPs would welcome additional knowledge, skills, and resources to help them serve the Wyoming agricultural community more effectively.

This bulletin presents a list of skills, knowledge, and resources that many TSPs who participated in the focus groups see as outstanding needs that would help them better assist Wyoming agricultural producers. Data needs include first and foremost more weather stations, but also better tools and apps to translate raw weather station data into information that is usable in producer decision-making. Human resource needs include trainings and webinars in climate science, including data analysis and interpretation. Additional needs include peer-to-peer support and climate communication. Finally, focus group participants described many research and research translation needs that would help them and their clientele increase awareness, preparedness, and response to weather/climate variability and water availability challenges in the Wyoming agricultural sector.

FOR MORE INFORMATION

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APPENDIX A. FOCUS GROUP DISCUSSION SCRIPT

Approved Study - University of Wyoming IRB Protocol No. *#20230531KH03583*

Focus Group Discussion Script & Questions

Facilitator/recorder name:

Date:

Location:

[State] Agricultural Technical Service Provider Weather, Climate, and Water Availability Needs Assessment

A. Introduction & Opening Remarks (*10 min*)

B. Ground Rules (*2 min*)

- Everyone's perspectives are heard and respected.
- There are no right or wrong answers.
- There are many people here and it is important that we hear the views and experiences of everyone—so please speak up and share your voice and thoughts on the questions and listen to others when they are speaking.
- Each participant will maintain the privacy of the participation and responses of others in the group.
- All cellular phones are placed in silent or vibrate mode. If you must respond to a call during the session, please step out of the group and rejoin us as quickly as you can.

C. Introductions - Icebreaker (*5–10 min*)

Let's start with brief introductions (facilitator select one method).

- Let's go around the room and introduce ourselves including name, organization, and involvement with climate science data in your work. *OR*
- Pair up and introduce yourself including your name, organization, and involvement with climate science data in your work (2–3 rounds).

Are there any questions before we start? [*Pause and respond to questions*] Thanks again for participating, we will now begin the focus group discussion and start the recording.

D. Focus Group Discussion Questions: (*60–90 min in total*)

Facilitator Note – Key things to remember as you are facilitating:

1. Prompt the discussion with questions like, "What about you? What was different for you? "What was the same?" Or "Who has a different opinion or experience?"
2. Before you move on from each question, ask participants: Is there anything else anyone wants to add?

3. Only explicitly ask 'prompts' when the main question topics are not answered/discussed or there is a lull in the conversation and further motivation is required.

4. Always ask 'sub-questions.'

Discussion Questions: (*10–15 min per question category - can be shorter if fully answered*)

1. What do you see as the most important weather, climate, and/or water topics for the Wyoming agricultural community in the future? Please describe. (*10 min*)

Prompts:

a. Gaining access to useful climate science-related information, resources, and training

b. Working with ag producers/land managers to adopt new practices, technologies, and/or beliefs and behavior changes specific to climate science-related information

c. Water related: Timing and frequency of precipitation, type of precipitation (rain vs snow); Increased flooding and/or drought events; Water quality

2. When thinking about these important topics, what are you or other technical service providers already doing to navigate these challenges and opportunities? (*10 min*)

3. Current information sources (*10 min*)

a. What are your primary information sources for weather, climate, and/or water topics? (e.g., National Weather Service, the weather channel, the farmers' almanac, manuals, online websites, newspaper, radio)

b. If you have questions about weather, climate, and/or water topics, who in your network would you contact for additional information or help? Please provide examples. Individuals? Organizations/Agencies?

4. When thinking about these topics, what kind/type of additional data or information would you like to have? (*15 min*)

a. Is this the same as what your colleagues would say? Or different? If it is different, please explain.

1. Is this the same as what your clients would say? Or different? If it is different, please explain.

2. Where or how would you imagine your clients getting access to these data or information?

3. Do folks in this area feel like they need more weather stations? Please describe.

Read as intro to the next 3 questions: The next three questions are very similar to each other. The first one asks you whether your (and your peers) current **knowledge** about weather and climate meets climate-related demands in your position(s), the second asks about whether your **skills** are adequate, and the third asks whether you have enough **resources** to do your job. (*Ask each question for participants/peers, then can go back and ask about clients/producers collectively* (*part c*) *-> e.g., What additional skills and/or data/knowledge and/or resources do your clients/producers need?*)

5. Current **knowledge** (*10 min*)

a. Does your current knowledge meet your climate science-related job demands? For your peers?

   1. What additional knowledge would be helpful to meet those demands?

   2. What additional knowledge/info/data do your clients/producers need?

6. Current **skills** (*10 min*)

a. What about your current skills? Do your current skills meet your perceived climate science-related job demands? For your peers?

b. What additional 'skills' would be helpful to meet those demands?

c. What additional 'skills' do your clients/producers need?

7. Current **resources** (*10 min*)

d. What about your current resources? Do the resources you have access to meet your perceived climate science-related job demands? For your peers?

e. What additional 'resources' would be helpful to meet those demands?

f. What additional 'resources' do your clients/producers need?

8. To end, we want to know what you think are the best next steps, for all of us together, to support your efforts in building weather/climate awareness among your clientele (*15 min*)

g. What are the next steps, including key research, that would be useful to build agricultural resilience with your clients? What types of outcomes are most useful/usable?

h. How might UW researchers/extension specialists be involved?

i. What steps are required in building community resilience in the face of the topics discussed, specifically changes in water availability.

9. Is there anything else you'd like to add?

Thanks for your time and expertise!

APPENDIX B. CURRENT TECHNICAL SERVICE PROVIDER ACTIONS

Focus group participants were asked what they are already doing about the weather, climate, and water availability challenges facing the state. Below are some of their responses.

Table B1. Responses to the question, "What are you already doing about these challenges?"

Promoting education of and participation in existing programs
- Cost-share programs for aging infrastructure.
- Working to improve irrigation infrastructure.
- Livestock water development.
- Existing cost-share programs to adopt practices, install infrastructure, make other improvements.
- Existing federal crop insurance programs. A few that were listed: Emergency Conservation Program (heavy equipment costs to move snow, to get to their livestock to feed them), livestock loss program, livestock forage program (trigger determined by the U.S. Drought Monitor).
- Offering and keeping producers aware of existing emergency loan programs and other programs, including IRA money, NRCS ClimateSmart practices, Farm Bill programs more generally.

Education
- Water quality workshops.
- Public communication to make people aware that fire seasons are longer and explain to them what we can do to reduce the risk of agriculture fires. Reduce fuels, reduce risk, prep for fires lasting longer—all year, instead of seasonally.
- Introducing best management practices, both educationally and on the ground.

Data collection
- Weather monitoring snow surveys.
- Data collection, encouraging more data collection, conducting programs to encourage more data collection.

Management and technical assistance
- Encourage flexible grazing management and strategies.
- Listening to land managers: what's happening, what the needs are.
- Focus on flexibility.
- Being as flexible as I can with producers [who are grazing on the federal lands my agency manages] in terms of enabling outcome-based grazing, based on current conditions on the landscape.
- Making sure that everything is done in advance, and by the books, to ensure no federal funding opportunities are left on the table.
- Talking with producers about enterprises to add to the existing agricultural operation. (For example, what types of outdoor rec opportunities are available to them?)
- Encouraging Beaver Dam Analogs (BDA).
- Removing dead stuff from forest lands.
- Emergency response (e.g., sandbagging).
- Proactive response (e.g., flood mitigation: rebar enforcement in flood-prone areas).
- We have dam and water release plans in place; how much to release and when.
- We provide technical assistance to producers, to provide "climate resiliency," for example: Beaver Dam Analogs to extend the green zone; and working in upland regions to retain moisture higher up.

Research and tool development
- Research on different crop varieties and cropping practices, no-till, looking at marketing tools for livestock and crops, too. Helping producers be able to make some of those decisions, what to do with their livestock at different times of the year, based on market trends, weather, feed availability, etc.
- Our team listens to the needs and creates tools in response.

Data communication with clients
- Using weather data in conversation with clients. Encouraging people to use/access weather data to help them with their decision-making.
- Talking with producers about weather and climate variability using data and facts rather than in terms of climate change. Talking with producers by asking them what has happened to them in the past. But sometimes even that is difficult, because they have experiences that disagree with the statistical record.
- Getting folks to understand the data.
- Keeping producers aware of good weather data sources (NRCS/NOAA are good weather data sources).

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