Resilient Agriculture

Weather Ready Farms

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ATTRIBUTIONS

Resilient Agriculture: Weather Ready Farms

ISBN: 978-1-7340417-4-3

Publish Date: 6/2/2022

Citations for this publication may be made using the following:

> Williams, T., Schmitz, H., and Shulski, M. (2022). Resilient Agriculture: Weather Ready Farms 1st ed., 1st rev.). Kansas City: Extension Foundation. ISBN: 978-1-7340417-4-3.

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Welcome to Resilient Agriculture: Weather Ready Farms, a publication created for the Cooperative Extension Service and published by the Extension Foundation.

This work is supported by the New Technologies for Agriculture Extension (NTAE) grant no. 2019-41595-30123 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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Welcome to Weather Ready Farms!

The content of this publication is broken down into sections for ease of use. Those sections include the overview, an analysis of weather, climate, and climate change in the Plains and Midwest, a summary of the risks farms undertake, some resources farmers have available, and the Weather Ready Farms Model for use and adaptation to your specific region. As you proceed through the sections, consider the weather risks, how management practices mitigate or exacerbate a risk, and how to reward weather resiliency through management where you are.

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RESILIENT AGRICULTURE: WEATHER READY FARMS OVERVIEW

The Resilient Agriculture: Weather Ready Farms publication was created to help the agricultural industry become more resilient to weather extremes, climate variability and climate change. It is based on the Weather Ready Farms model developed by Nebraska Extension. The focus is primarily on field crop farms and producers in the Great Plains and Midwest regions of the United States. Many of the concepts and discussions within this publication can be utilized and adapted for other regions and agricultural operations.

No-till soybeans planted into corn residue in south central Nebraska.
Photo courtesy of David Keto, University of Wyoming, 2017

Climate Change and Agricultural Extension

Need for Climate and Weather Resiliency in Agriculture

The weather is usually the first conversation topic between agricultural operators in the Midwest and Great Plains. Not only does the weather change from day to day and provide new talking points, it also impacts farming operations and livelihoods. The weather during the season can be one of the largest factors affecting profitability and on-farm losses, such as devastating hail or drought. Olen and Auld (2018) showed that 85% of U.S. crop losses are caused by weather. Utilizing weather and climate resilient practices and strategies can lessen the impact.

In what year did you experience the most crop loss in your area? Was a single event the cause?

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Olen, B., & Auld, S. (2018). A roadmap for assessing relative risks for agricultural production. Choices, Quarter 4. http://www.choicesmagazine.org/choices-magazine/submitted-articles/a-roadmap-for-assessing-relative-risks-for-agricultural-production

Why Weather Ready Farms?

In 2015, Nebraska Extension set out to address the impacts that extreme weather and climate variability have on agriculture. This is an important and challenging topic due to the extreme variability in our weather and climate, as well as the diversity of agricultural operations. Through many discussions with stakeholders, the team developed a program that would reduce the whole-farm risk to losses from weather events. Over and over, the risk reducing strategies discussed with farmers primarily dealt with the day-to-day (or season-to-season) weather variations and extremes.

The goal for Nebraska Extension was to create a model for enhancing, and rewarding, weather and climate resiliency on farms through multiple engagements, not a one-time workshop or publication. A single engagement with a stakeholder is highly unlikely to accomplish the changes necessary to make farms more resilient. Additionally, each operation is unique, and this program allows for local and regional differences in recommended farming practices.

Saturated early-season corn in southeast Nebraska. Photo courtesy of Tyler Williams, University of Nebraska, 2015.

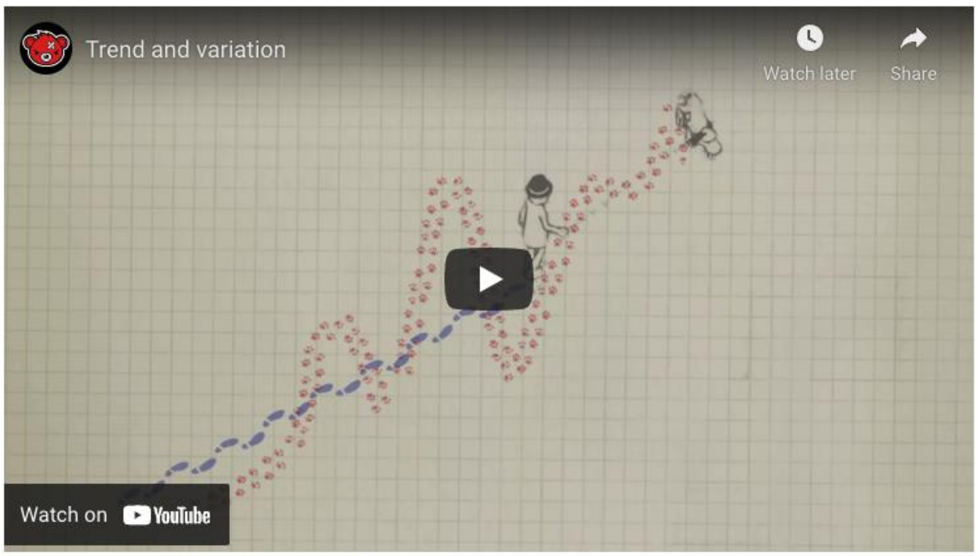
The Weather Ready Farms (WRF) program was created and initially focused on cropping systems, specifically the common corn-soybean rotation. The WRF program model uses a state- or region-specific self-assessment to provide recommendations to producers and gauge their current "weather-readiness." This is the starting point to a longer discussion, and larger program, to enhance the resiliency of the producer's operation.

There is opportunity to expand this model to other regions and agricultural sectors (beef, swine, etc.), and this publication will help serve as a guide. Feedback is welcome on the guide and any suggestions for improvement. We are hoping that you will share challenges and successes of using this guide for your programming.

OVERVIEW OF CLIMATE AND WEATHER

A metaphor used to distinguish weather from climate holds that weather is your mood and climate is your personality.

A metaphor used to distinguish weather from climate holds that weather is your mood and climate is your personality. Weather represents the day-to-day state of the atmosphere (e.g., air temperature, moisture, wind speed), whereas climate represents an average of those day-to-day weather conditions over a longer period of time (usually 30 years). Weather is determined by factors such as the position of the jet stream and areas of high and low pressure. Differences in temperature and moisture around the globe act to drive these factors. As such, the atmosphere is a dynamic component to our climate system.



https://youtu.be/e0vj-0imOLw

Climate is a comprehensive look at the weather and tells the range of weather conditions one might experience in a given location. There are several factors that determine our climate in the Plains and Midwest of the United States. Our mid-latitude location results in seasonal differences of incoming solar radiation. We are at a continental location rather than near an ocean, which keeps temperatures more variable on a day-to-day basis and throughout the year. Prevailing winds are from west to east; therefore, weather systems move in this general direction across the region. We are also under the influence of the jet stream and how wavy it is, whether it brings warmer southerly air (which another term is, having the same temperature and humidity properties) or colder northerly air. Regional-scale factors also influence our climate. Within the central U.S., features such as the Great Lakes can modify the regional climate conditions for portions of surrounding states, most notably perhaps with lake-effect snow.

We often rely on forecasted weather conditions, which are predictions made from one hour to ten days into the future. This provides us with expected high and low temperatures as well as amount and/or probability of precipitation, wind direction and speed, humidity levels, and other variables from which to base our decisions (Figure 1). Past this timeframe, we rely on climate outlooks that provide strictly a probability of above- or below-average conditions, rather than a specific value (Figure 2). In the case of an outlook, there is usually too much uncertainty in these model predictions to provide an amount of precipitation, but rather a trend (wetter or drier than average). These outlooks are often relied on for farm management decisions made at the seasonal scale, or several months to a year into the future.

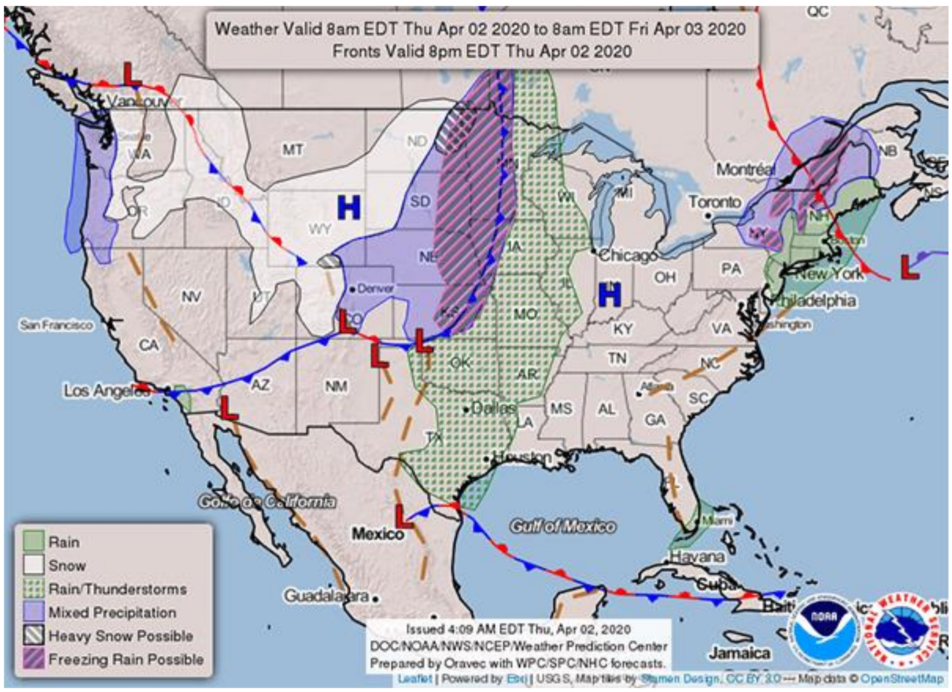


Figure 1 - Weather forecast map example, showing position of low and high pressure areas, fronts, and possible precipitation.

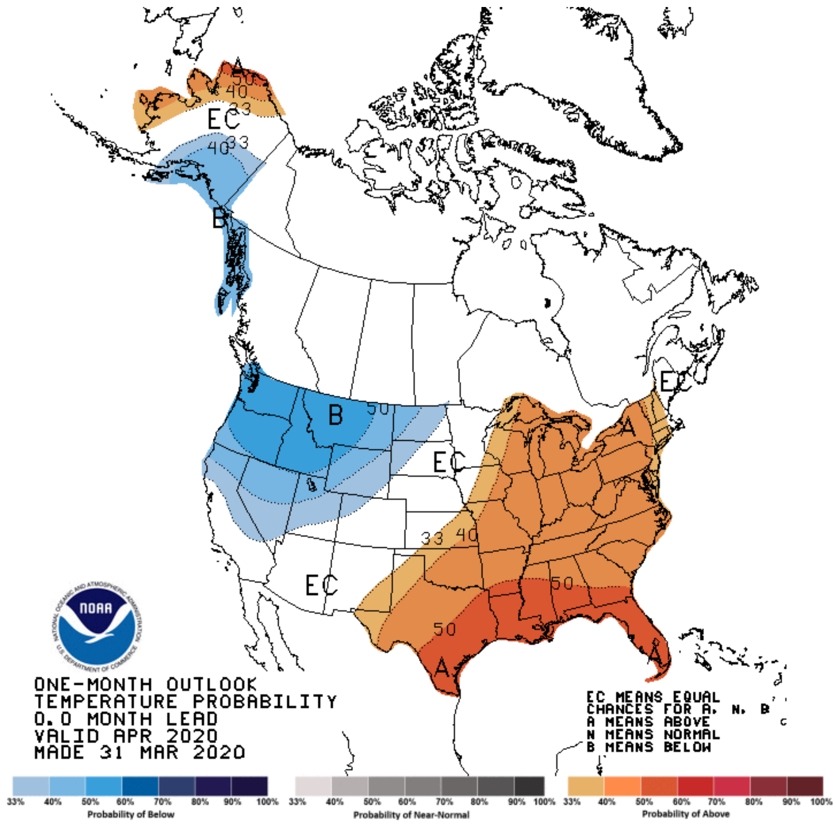


Figure 2 - Climate outlook example, showing the probability of below normal (blue) and above normal (red) temperatures for the month of April, 2020. The area in white represents equal chances (probability) of having above, near, or below normal temperatures. Similar outlooks are available for precipitation conditions

Climate of the Plains and Midwest

Due to specific factors that control our regional climate, much of the Plains and Midwest experience a humid continental type. Continental climates are classified as such because of their warm or hot summers and cold winters. Southern portions of the region (Kansas, most of Missouri, southern half of Illinois, Indiana, and Ohio) are warm enough that they are classified as a humid subtropical climate type. The western reaches of the Plains (eastward side of the Rockies, non-mountainous but higher altitude) experience a drier climate type known as semi-arid or steppe.

A distinctive feature of this region is the marked east to west gradient in precipitation and humidity. On average, the Midwest receives twice as much precipitation on an annual basis when compared to the western High Plains. Precipitation is highest (40-50 inches) in the humid subtropical areas of eastern Kansas, most of Missouri and southern Illinois, Indiana and Ohio. The precipitation gradient is strongest for Kansas and Nebraska with a 50% reduction in the annual average total. Meanwhile, the western High Plains averages 12-16 inches per year. There are distinct wet and dry seasons with precipitation peaking in spring and summer and reaching a minimum in winter.

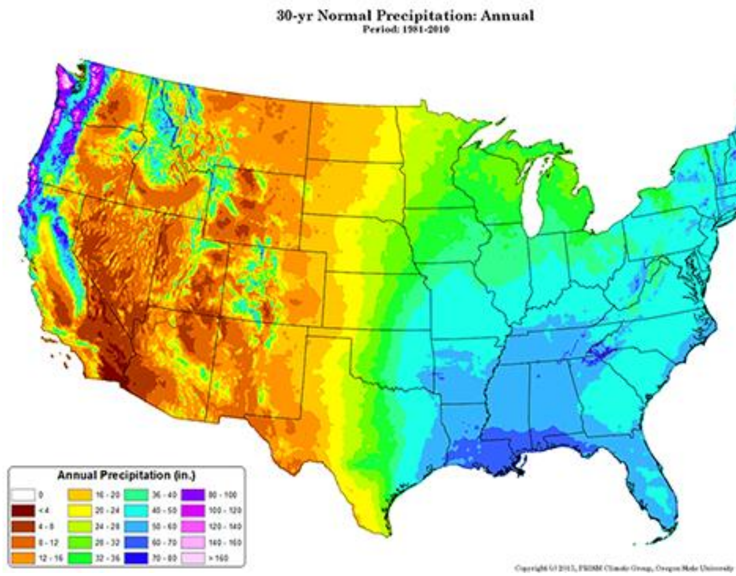


Figure 3 - Average annual precipitation (inches) for the period 1981 – 2010. Source: http://www.prism.oregonstate.edu/normals/

Annual average temperatures have a general latitudinal gradient of colder in the north (around 38°F along northern North Dakota and Minnesota) and warmer in the south (mid 50s). Typically, January is the coldest month of the year and July is the warmest month. The growing season (time of year when temperatures continuously stay above freezing) is longer in the south (mid-April to mid-October) and shorter in the north (mid-May to mid-September).

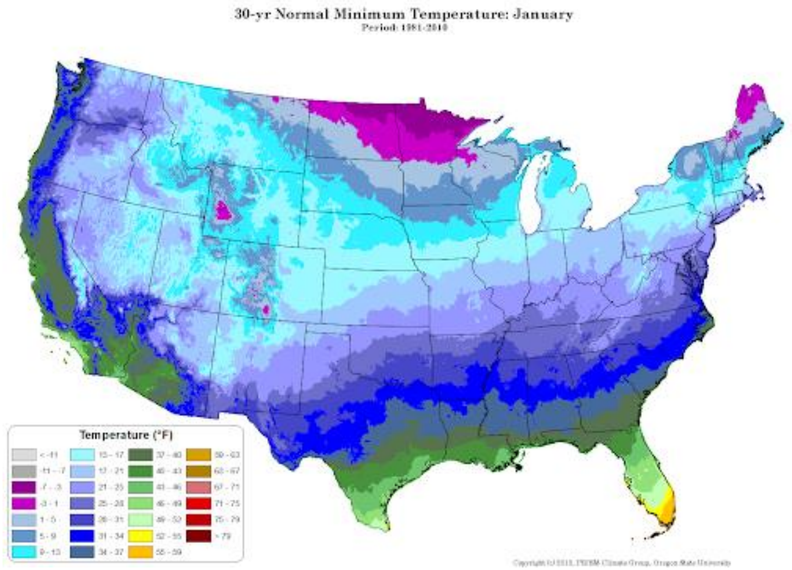


Figure 4 - Average January low temperature (°F) for the period 1981 – 2010. Source: http://www.prism.oregonstate.edu/normals/

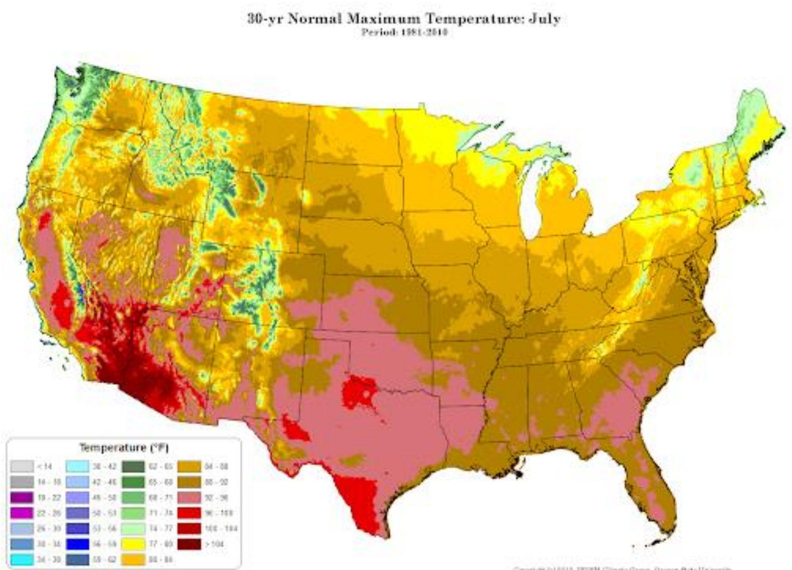


Figure 5 - Average July high temperature (°F) for the period 1981 – 2010. Source: Northwest Alliance for Computational Science & Engineering. (2020). 30-Year normals. Prism Climate Group. http://www.prism.oregonstate.edu/normals/

Year-to-year variability in both temperature and precipitation is high for this region. Drought and flood are both common occurrences. Sometimes conditions can change quickly from one extreme to another. For example, portions of the Missouri Basin were impacted with heavy snowfall, rain, and flooding during 2011, while the following year (2012) was characterized by widespread drought conditions and anomalous warmth.

What type of operation do you have?

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Climate Change

Our climate varies naturally as a result of large-scale pattern shifts in the ocean and/or atmosphere. One such example is El Niño and La Niña, phases in ocean circulation and associated atmospheric patterns in the equatorial Pacific that have ramifications on the weather globally. These events cycle and are short-lived, lasting on the order of a few months to a few years. We also experience changes in our climate due to other factors, such as volcanic eruptions that temporarily cool the global average temperature.

Humans influence the climate by altering the environment (building and expanding urban infrastructure, irrigating crop fields) and emitting greenhouse gases. There is a naturally-occurring greenhouse effect in which gases in our atmosphere, such as water vapor, carbon dioxide and methane, absorb and re-emit thermal energy. Water vapor and carbon dioxide keep atmospheric temperatures ~60°F warmer than if these gases were not present – a good thing as life on Earth would not be possible without this greenhouse effect! However, due to an artificial buildup of greenhouse gases, largely from fossil fuel combustion, the natural carbon cycle is not able to keep up and is therefore out of balance. As such, global average temperatures are on the rise and causing shifts in not only temperature, but precipitation regimes, more extreme drought and flood events, heat waves and storms.

Over the last century, the earth has warmed about 1.5°F, however there is regional variability to the rate of warming. The overall warming has caused local and regional changes including setting more heat than cold records. Precipitation is changing with wet areas getting wetter, and dry areas getting drier, sea levels are rising, and frozen regions of the world are melting, particularly in the Arctic. Primary ways that the agricultural sector can mitigate its impact on the climate is to reduce emissions of greenhouse gases, increase efficiency and resource management, sequester more carbon in the soil, and improve soil health.

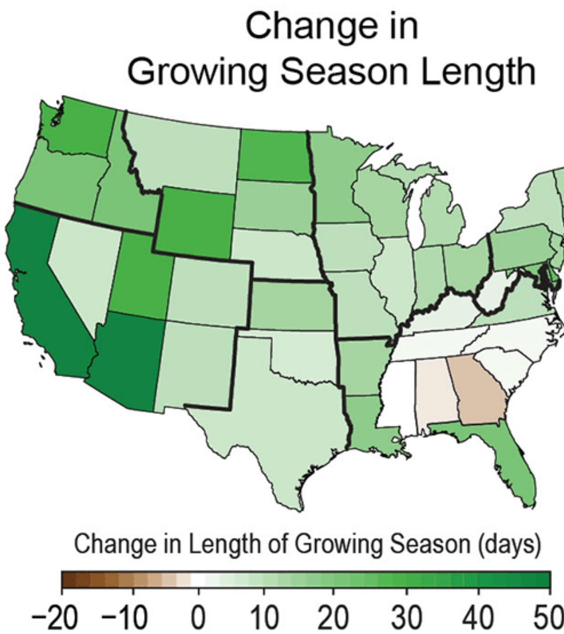

Image of change in growing season length by state. Source: https://nca2018.globalchange.gov/chapter/appendix-3/

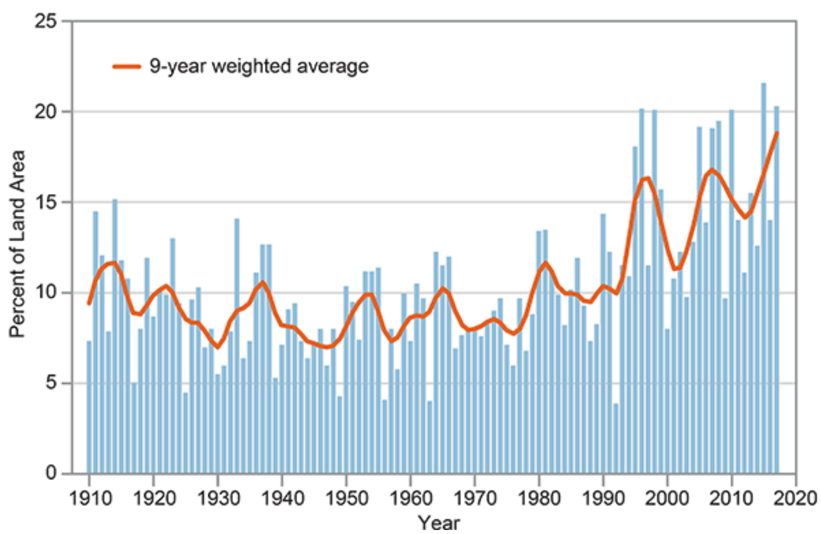

Image of trend in land area experiencing extreme precipitation events over time. Source: https://nca2018.globalchange.gov/chapter/10/

Image of native prairie strips into row cropping system. Source: https://nca2018.globalchange.gov/chapter/21/

Do you think you have personally felt the impact of climate change?

Historical Climate Trends of the Plains and Midwest

There are reliable and systematic climate observations that date back to before the turn of the last century. Analyses of these data indicate that the Plains and Midwest have warmed on an annual average basis by about 1°F to 1.5°F since 1900. The trend is strongest during the winter and at night. Summer temperature trends show that southern portions of the region are cooling slightly whereas northern and western portions are warming. Temperature extremes have shifted such that the cold events are becoming less cold, by several degrees, as well as less frequent while the long-term change in warm temperature extremes show an overall cooling. The warmth of the 1930s partly attributes to this seemingly reduction in extreme warm days. In addition, studies also point to the increase in agricultural intensity altering atmospheric water vapor content through increased evapotranspiration is attributing to this trend.

Precipitation in the area has seen a general increase in the annual averages by about 10-15% over the past century. The trends are strongest and most pronounced during spring and fall with an increase of 15% for much of the region. Winter and summer trends are more variable in the Plains and Midwest with some portions getting wetter, some getting drier. Heavy precipitation events are generally on the rise across the region.

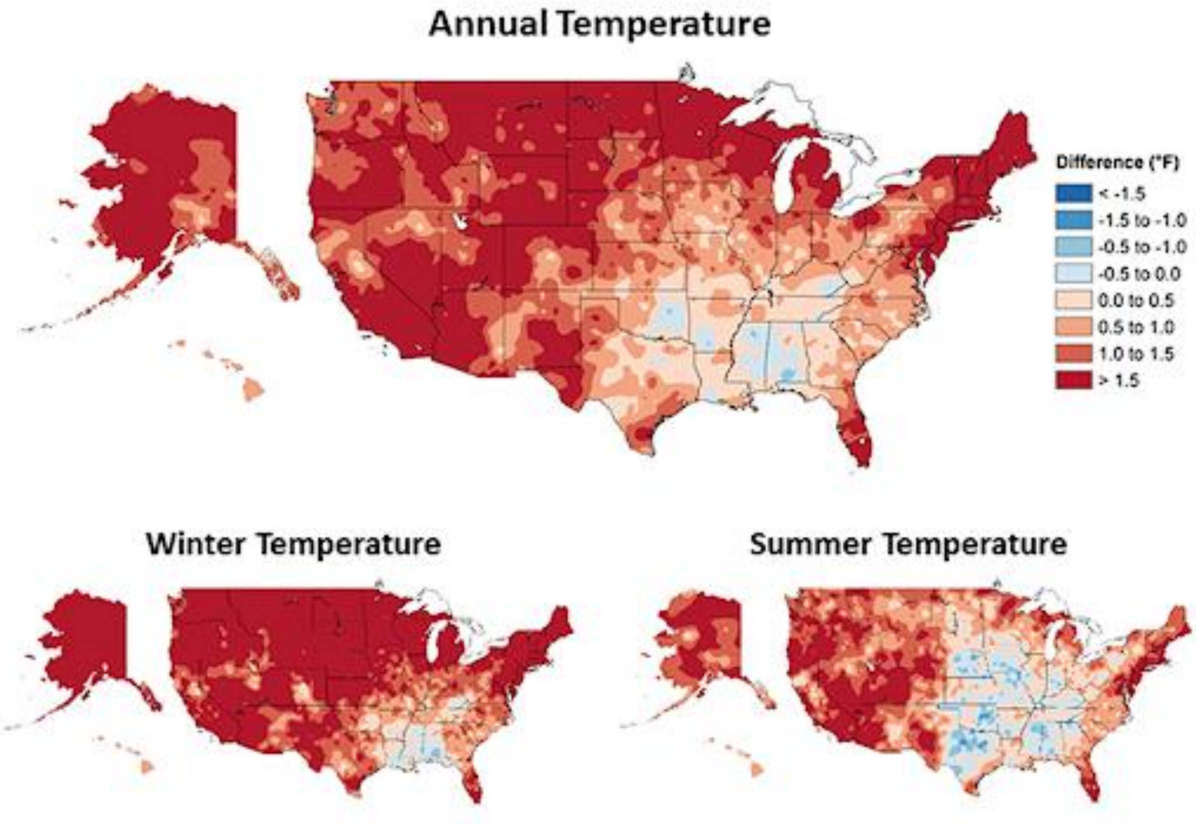

Figure 6 - Observed changes in annual, winter, and summer temperature (°F). Changes are the difference between the average for present-day (1986–2016) and the average for the first half of the last century (1901-1960). Source: https://science2017.globalch

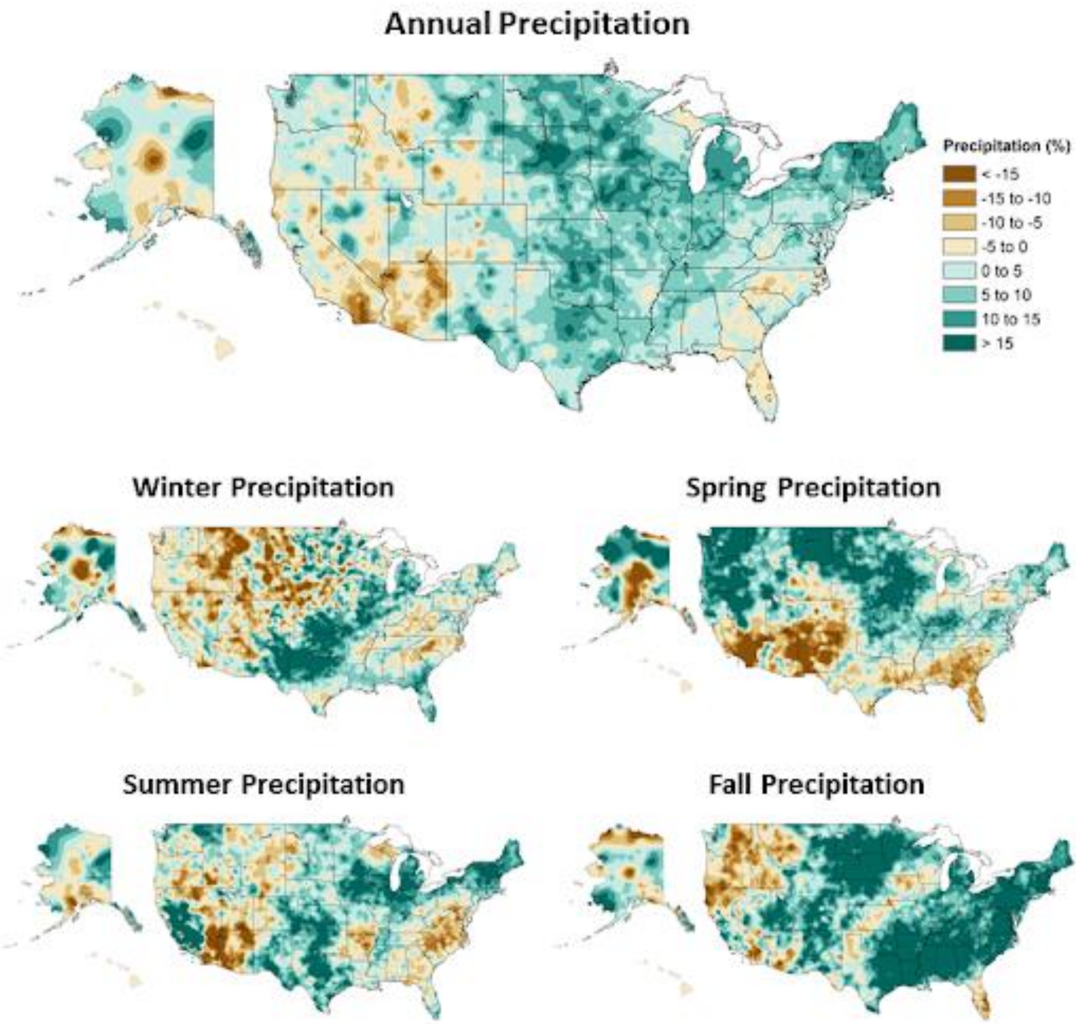

Figure 7 - Annual and seasonal changes in precipitation over the United States. Changes are the average for present-day (1986–2015) minus the average for the first half of the last century (1901–1960). Source: https://science2017.globalchange.gov/chapter/7/

What changes have you seen in your area?

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Climate Projections

As we can use simulations to forecast the weather, we can also run climate models to understand how our climate will change in the future. Climate projections are available for the next decade through the end of the century (2100). By investigating different scenarios of greenhouse gas concentrations in our atmosphere, we can assess our pathways of future climate, and identify associated impacts. The reason for differing scenarios is the uncertainty associated with human behavior and climate mitigation efforts.

According to the simulations, annual average temperatures for this region are projected to be about 4°F warmer than the current averages (1976-2005) by mid-century (2050) and as much as 9°F warmer by the end of the century (2090). This would mean that the average annual temperature for Des Moines, IA would be like that of present-day Topeka, KS in 2050 and Stillwater, OK by 2090. The warmest days of the year will see a temperature increase by about 7°F by mid-century and the number of days warmer than 90°F will double. The area will gain about 30 days in the growing season length as the number of days we stay above freezing will increase.

As the region has experienced an increase in precipitation over time, this trend is projected to continue into the future. Climate models predict winter and spring precipitation to increase by 10-15% across much of the Plains and Midwest by mid-century, relative to the current respective averages. Summer conditions will be drier overall, with a reduction of about 10%. Fall is projected to be slightly wetter (drier in Kansas and much of Missouri), with the least amount of certainty in these seasonal projections. Heavy rain events are projected to increase in intensity across the region. Even though the region is projected to get wetter overall, this will be punctuated by drought events.

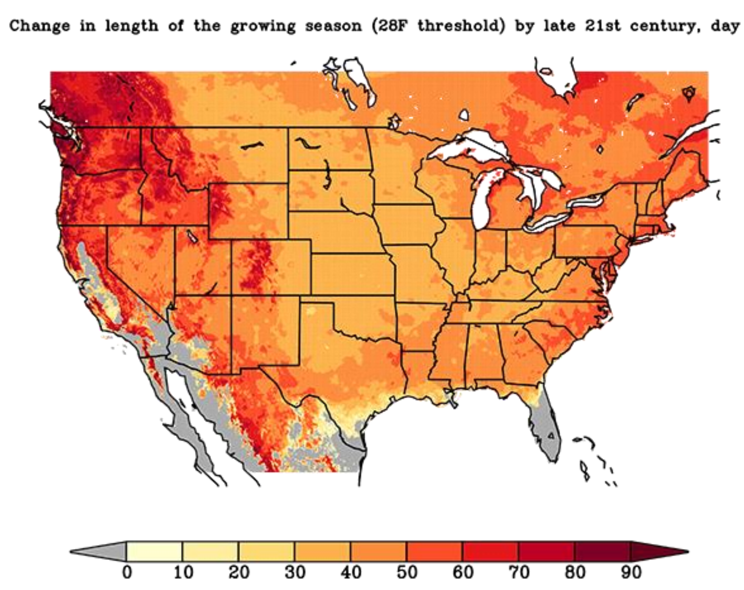

Image of the change in growing season length at the middle of the century using a high emissions scenario. Source: https://scenarios.globalchange.gov/loca-viewer/

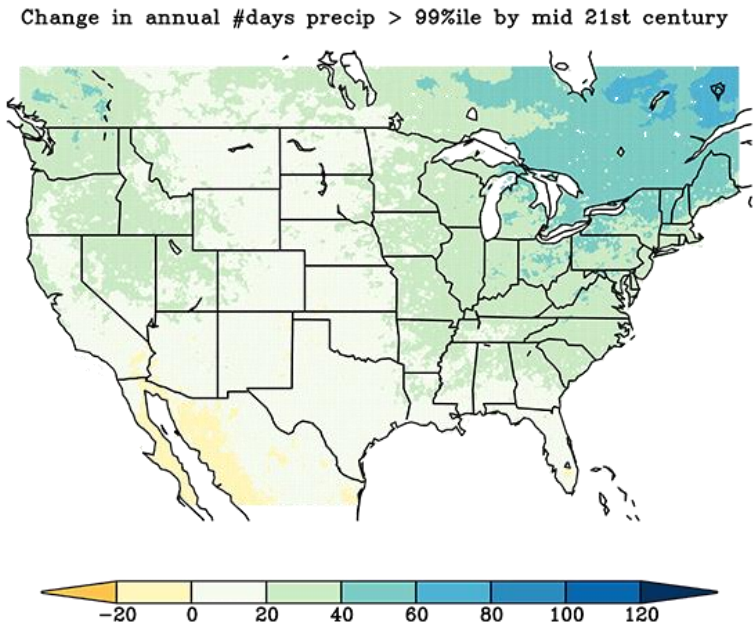

Image of the change in the annual number of days with precipitation greater than the 99th percentile at the middle of the century using a high emissions scenario. Source: https://scenarios.globalchange.gov/loca-viewer/

What is the biggest climate-related challenge for your operation?

Climate Change Perceptions and Social Science

Surveys of the American public are performed regularly to gage perceptions on our changing climate. A majority of those surveyed agree with the statement that global warming is happening and humans are the primary cause. There is a disconnect, however, when it comes to the question of whether people feel that it impacts them personally. Science shows that climate change is real and here now, impacting all of us. However, there is a gap with scientific understanding and public perception.

Climate is what drives the weather events we experience and also represents how climate change is manifested. Shifts and changes in weather extremes are a way in which we 'feel' climate change. Often it is the extremes (such as heat waves, droughts and floods) that are more impactful than changes in the averages.

Social science research points out that framing discussion around our changing climate is paramount for successful dialog. Communication that highlights extreme weather, efficient resource management, health, and economics are some ways in which we can all come together on this paramount topic.

Where do you think you fall on the six America's scale for concern on global warming?

- **Alarmed**
- **Concerned**
- **Cautious**
- **Disengaged**
- **Doubtful**
- **Dismissive**

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Watch: Resource: Video on Six Americas Yale Program on Climate Change Communication. (2018, February 12). What are global warming's six Americas? [Video]. YouTube. https://youtu.be/ccze5kyyxNU

FARMER RISK OVERVIEW

Although weather and climate change are most directly risks to production, the effects of adverse weather can be indirectly felt in any risk category.

Agriculture has many risks that can be broken into categories based on the source of the risk: production risk, marketing risk, financial risk, human risk, and legal risk. Although weather and climate change are most directly risks to production, the effects of adverse weather can be indirectly felt in any risk category. According to the article from Purdue University, Center for Food and Agricultural Business. (n,.d.,), production risk is the most important source of risk for most farmers in their sample.

Climate risk is a term often discussed as there is increased risk due to changing weather variability and extremes. The capacity of a farm to be resilient to future climate risk, in addition to many other sources of risk, is important to their longevity and success. Examples include: changing cultivars, increasing farm or crop-rotation diversity, or planting longer season varieties.

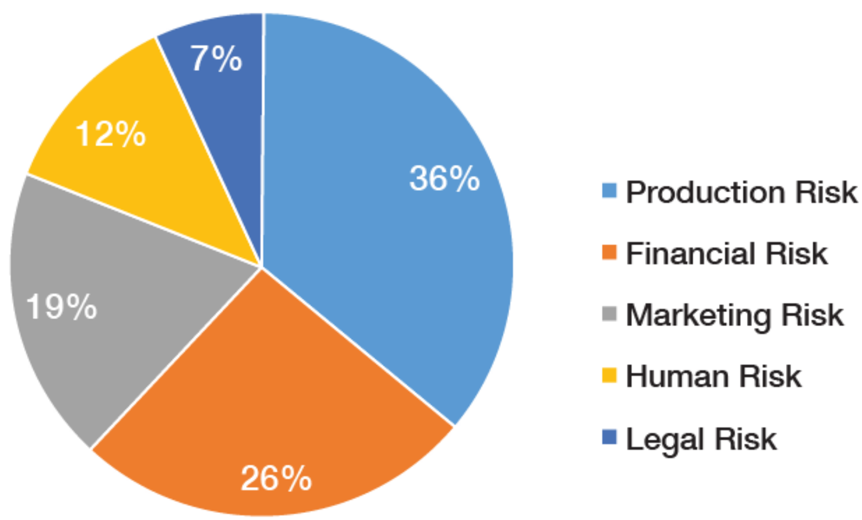
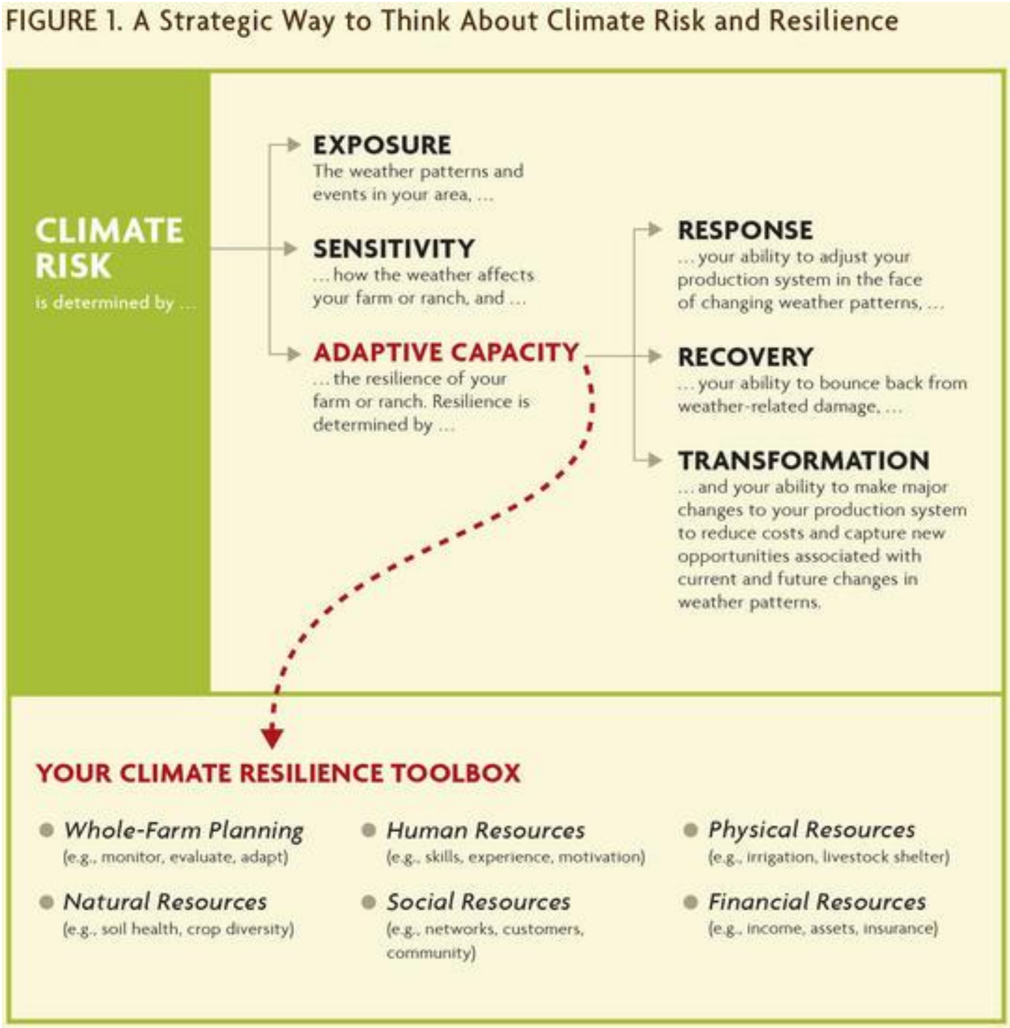


Figure 1. Random parameter logit (RPL) preference shares for risk areas

Producer perceptions of agricultural risk in 2017. Center for Food and Agricultural Business. Source: https://agribusiness.purdue.edu/producer-perceptions-of-agricultural-risk-in-2017/



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What is the greatest risk to farms in the future?

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Losses to Extreme Events: Drought

Drought is one weather risk that nearly all agricultural operations must deal with and it can have significant impact on production. From 1989 to 2018, the USDA Risk Management Agency (RMA) issued a total of $48.1 trillion in indemnity payments for drought-related losses on all covered commodities in the United States (USDA Risk Management Agency (n.d.)). Agricultural drought is influenced by precipitation shortages, reduced water availability (topsoil, ground, or surface), and differences between actual and potential evapotranspiration, among other variables, as it relates to the needs of the plant or crop.

Drought damage on corn. Photo courtesy of Vicki Jedlicka, University of Nebraska, 2012

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Losses to Extreme Events: Wind

Another concern for producers is crop loss due to extreme wind events or thunderstorms. Severe wind storms can cause crop loss by breaking or leaning plants over or by causing the fruit of the plant to fall off. Wind can also influence plant growth and productivity by altering evapotranspiration, turbulence, or soil loss and deposition. In 2019, the NOAA Storm Prediction Center recorded over 16,000 wind reports in the United States, which was the most since 2011.

Center pivot flipped by strong winds. Photo courtesy of National Weather Service, 2017

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Losses to Extreme Events: Flood

Flooding can cause severe crop and infrastructure loss and damage as well as prevent crops from being planted altogether, which was evident across a large portion of the United States in 2019. Flooded soils can reduce the oxygen available to plants, disrupting necessary plant functions, such as photosynthesis and nutrient uptake. The duration of flooded conditions plays a large role in plant survival. For corn, flooding that lasts longer than four days, especially in warm conditions, greatly reduces the chances of survival. Soils that have been flooded can also experience severe nutrient loss, remain too saturated for planting, and can have surface characteristics altered, such as sand or sediment deposits, which reduce plant productivity.

https://youtu.be/30OPitPetOw

Flooded fields and roads in eastern Nebraska. Photo courtesy of Market Journal, 2019.

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Losses to Extreme Events: Hail

Hail causes in excess of $1 billion in economic losses each year to communities and industries, with the epicenter of hail events in the Great Plains. Most hail events occur in late-spring and early summer, which is when many row crops are rapidly growing. Late-season hail events can be especially impactful because crops are mature and may damage easily, plus there is very little growing season left to plant a new crop. The timing of a hail event determines the recovery process and damage evaluation. For early season damage, waiting for a week to assess the damage may be necessary in order to determine actual plant death. If plants do survive, other challenges, such as pest or disease pressure, may appear later in the season. It does not take large hail to cause impacts. Small hail, often in combination with very strong winds, can also cause significant damage.

Hail damage to corn in south central Nebraska. Photo courtesy of Tyler Williams, University of Nebraska, 2018

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Losses to Extreme Events: Frost/Freeze

From 1989-2018, USDA-Risk Management Agency paid just over $4 billion in indemnity payments for commodity losses due to a freeze. The risk of having frost and freeze damage is highly dependent on time of year, crop type, stage of development, and duration. Frost conditions can change within a field and are influenced by topography, with lower elevations in the field having the highest risk. The critical temperature often discussed for corn and soybean damage is 28°F for freeze damage and 30°F-36°F for frost damage, but other crops, especially specialty crops, may have different thresholds and impact. Frost damage may show some symptoms, but freeze damage may cause plant death.

Frost and freeze statistics are used to calculate risk of reaching these temperature thresholds on certain days of the year. Changes to these dates for frost and freeze risk pose additional challenges to crop producers.

What weather event causes the greatest loss to agriculture in your area?

- **Drought**
- **Wind**
- **Hail**
- **Flood**
- **Frost/Freeze**
- **Other**

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Losses to Extreme Events: Others

Other losses such as tornadoes, heat waves, and cold waves can cause damage and losses to crops and farms more broadly. The risk of having at least one of these events cause damage in an area is quite high due to the extreme and variable nature of the weather that makes up a region's climate.

Image of Crop Circle

Nutrient Losses

Wet soils, excess rainfall, and warming soil temperatures all contribute to nutrient losses in cropland. These nutrients are either lost to groundwater, surface water, the atmosphere, or below the rootzone and out of reach by the plants. In addition to the direct economic loss of nutrients and potentially reduced crop yield, these losses have an environmental impact. Reducing these losses therefore provides an economical and environmental benefit.

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Soil Losses

Soil can be lost from crop land through wind or water erosion. Heavy rainfall events, flooding, and drought conditions can contribute to the detachment and transport of soil particles, causing problems with agricultural productivity and water quality. The Revised Universal Soil Loss Equation-Version 2 (RUSLE2) calculation used by the USDA-NRCS, one example to estimate soil loss due to rainfall, utilizes multiple factors, such as climate, soil type, topography, and land use. Rainfall intensity, duration, amount, and time of year influence the soil loss due to water. The Wind Erosion Prediction System (WEPS) is used by USDA-NRCS to simulate soil loss by wind.

Dust blowing due to strong winds in central Nebraska. Photo from the Nebraska State Patrol, 2018

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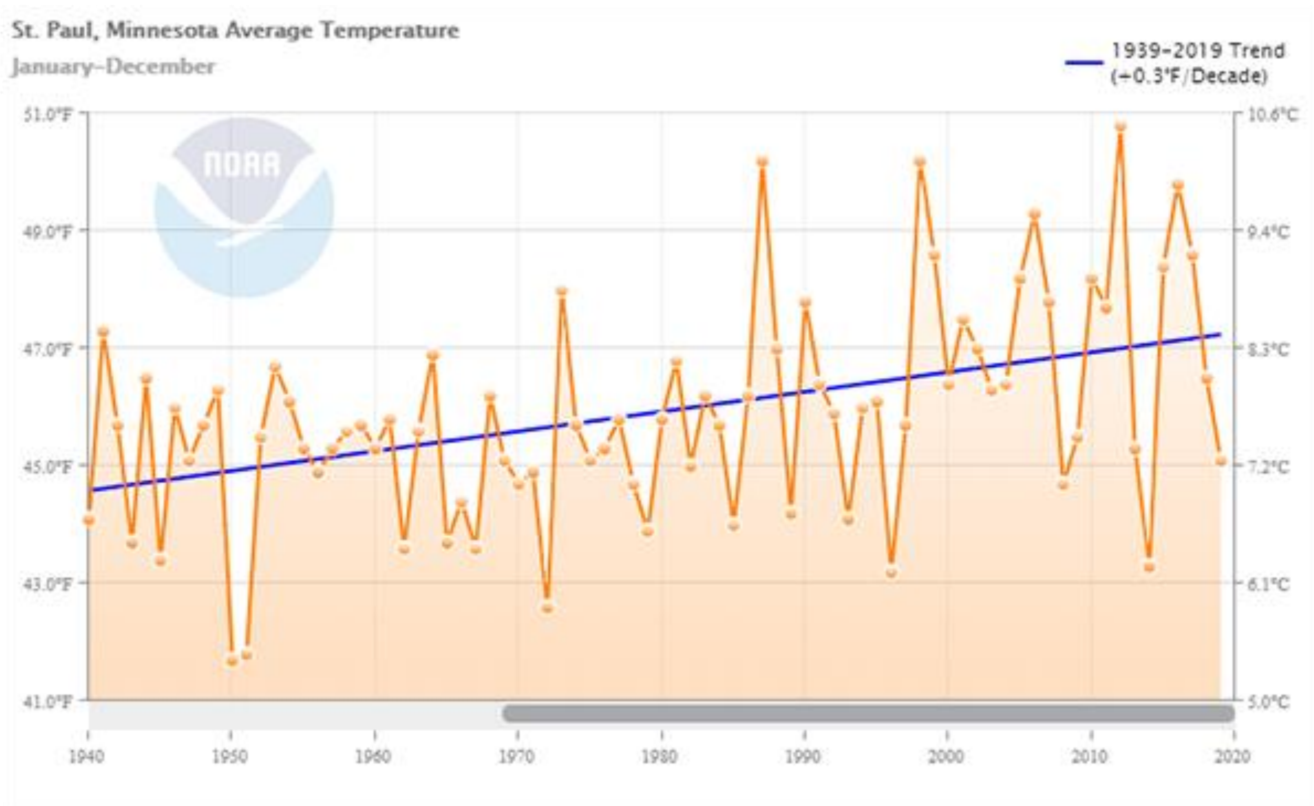
Risk from Climate Change

As indicated many times in this publication, weather poses a significant challenge to agriculture. Changes in weather patterns over the long-term (also known as changes in the climate) will alter these challenges to agriculture, thus influencing pest development, crop growth, water availability, etc.



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Climate Change: Extreme Events

The projection for the Great Plains and Midwest is for extreme events, such as heavy downpours, flooding, heat waves, and drought, to increase in the future. Although these events are common in this region, an increase in frequency could put extra stress on farms already feeling plenty of pressure from these losses.

Strong winds "green-snapped" one variety of field corn. Photo Credit: Hans Schmitz

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Climate Change: Pests

Pest management is a persistent challenge in cropping systems. Weeds, insects, and diseases are common pest challenges, and the impacts are often influenced by weather conditions. Changing weather conditions will alter the frequency, type, and intensity of pest pressure. For example, the increase in humidity in the Midwest has created favorable conditions for diseases and pathogens. Also, warmer temperatures and an extended growing season have enabled the northward expansion and increased likelihood for overwintering survival of pests. This trend of increasing humidity and warmer temperatures is expected to continue, adding to the region's challenge of managing new and emerging pests.

Proximity to field edges increase habitat for voles and other plant pests.

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Climate Change: Water

It is often said that "climate is water". Water is a key component in current and future climate challenges, and the amount, location, and physical state determine the impact of having too much or too little. Warming temperatures will change the state (liquid, gas, or solid) and demand of water. An increase in heavy rainfall events, drought, reduced mountain snowpack, among others, are all risks to our water system due to a changing climate.

In agriculture, too much or too little water creates many challenges. Too much water washes away nutrients, drowns out crops, or prevents field work from getting done. Too little water creates drought stress, plant death, and reduced groundwater and surface water levels. Damage from flooding to infrastructure and to the land can be catastrophic to farming operations, as well as many other industries and communities.

The quality of the water is another challenge. Warming temperatures and increasing heavy precipitation events contribute to the conditions for harmful algal blooms, creating poor conditions for recreation, habitat, and drinking water. Nutrient and sediment losses to the environment from erosion or saturated conditions reduce the quality of our groundwater and surface water.

On a larger scale, reduced sea and land ice, and an increase in sea levels, create additional challenges beyond water quantity and quality. Infrastructure and transportation of agricultural materials and goods outside of the Great Plains and Midwest can also be influenced by these risks outside of the region.

Aftermath from flooding of White River near Crawford, NE. Photo courtesy of Gary Stone, University of Nebraska, 2019.

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FARMER RESOURCES OVERVIEW

To reduce the weather and climate-related risks inherent to farming, a variety of tools and resources are needed.

To reduce the weather and climate-related risks inherent to farming, a variety of tools and resources are needed, from those relatively easy to obtain (such as online weather forecasts) to those requiring significant external partnership (such as access to affordable crop insurance). Resources include current farm management practices already known to reduce risk, knowledge of new or alternative practices, and resources for implementing them, including insurance products and disaster assistance programs to help protect against remaining risks.

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Best Practices for Reducing Risk

How do we reduce risk associated with extreme weather and changing climatic conditions?

Farmers have a variety of best management practices available for reducing the risks associated with extreme weather and changing climatic conditions. Approaches include best agronomic and economic management practices, among other tools and resources. Adoption of these practices relies on their use and recommendation by a variety of trusted sources. Farmer peer groups are one influential example. Many of the practices described below and resources mentioned utilize peer groups for implementation.

Youth examine dairy facilities and animals during judging events. Photo Credit: Hans Schmitz

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Best Agronomic Management Practices

Agronomic management practices constitute those actions that produce a high-yielding crop in an efficient manner. Efficiency limits waste and promotes the production of quality products. The American Society of Agronomy recognizes four categories of agronomic management practices in their Certified Crop Advisor professional development and recognition program: nutrient management, pest management, crop management, and soil and water conservation. We summarize resources in each of these four categories related to weather risks.

In which category of agronomic management principles do you or your farmers struggle with most?

- **Pest Management**
- **Nutrient Management**
- **Crop Management**
- **Soil and Waste Management**

Nutrient Management

Industry and academia have teamed together to promote the 4R Nutrient Management approach. The 4 R's of nutrient management include: right rate, right place, right source, and right time for nutrient use. When used appropriately, 4R Nutrient Management can reduce weather risks associated with nutrient loss, runoff, or inaccessibility to the crop.

The interaction of water with nutrients creates variation in plant health and emphasizes the 4R approach. Photo credit: Hans Schmitz

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Pest Management

Integrated Pest Management (IPM) consists of a suite of management practices that effectively controls pests while minimizing chemical exposure and off-target movement of pesticides. Effective IPM strategies help reduce pest populations and movement, and increase control, which are often influenced by weather and climate.

Combines lined up for a quick harvest. Photo courtesy of Tyler Williams, University of Nebraska

What pest most concerns you? What IPM tools are most commonly for management?

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Crop Management

Crop management concerns beyond nutrients and pests include crop selection, variety selection, planting dates, seeding depth, tillage practices, and other practices such as cover crops for moisture and weed management. Choosing these practices carefully can help reduce weather-related risks, such as wind damage, waterlogged soils, soil erosion, disease spread, and plant stress during droughts and floods.

No-till farming can be one tool to improve soil health. Photo courtesy of Tyler Williams, University of Nebraska

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Soil Health and Water Conservation

Extreme weather events, like heavy downpours and flooding, can cause profound amounts of soil erosion. Soil and water conservation practices help keep soil in place and increase water use efficiency. Topsoil is the most productive of the soil horizon, so prevention of its erosion is key to conservation. Soil conservation practices may increase soil quality and function when practiced in the long run. The Soil and Water Conservation Society is a national organization that studies science-based management practices for conserving soil and water resources.

The five principles of soil health include minimizing soil disturbance, providing soil armor, plant diversity, continual live-plant roots, and livestock integration. The main goal of soil health is to create organic matter, which can cycle nutrients and provide biologically for a crop with fewer chemical and physical inputs. Organic matter can increase water holding capacity, which matters greatly during drought and flood events. Practices that increase soil health generally increase weather and climate resilience.

Annual waterways provide a great way to reduce soil erosion. Photo courtesy of Tyler Williams, University of Nebraska

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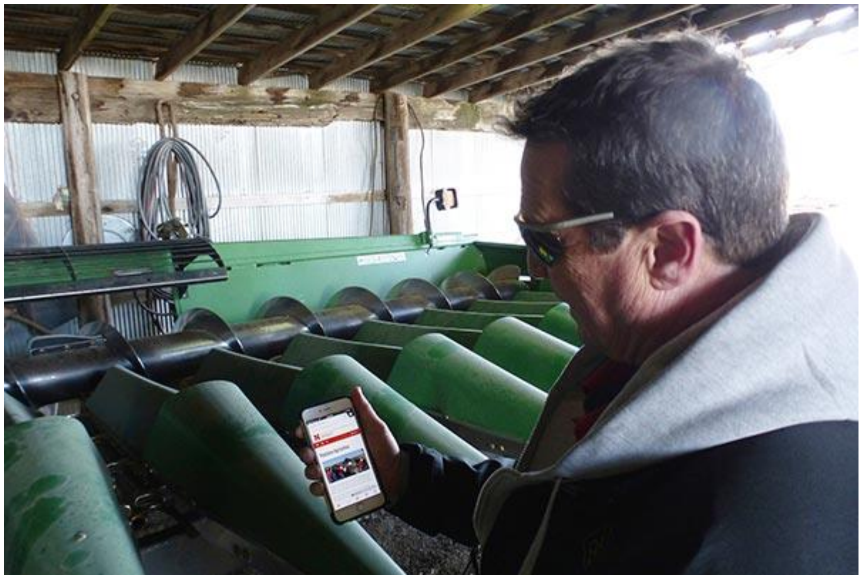
Weather and Climate Data for Decision Tools

Data in agriculture is a booming industry, and weather and climate data are key inputs to it. Companies, universities, and non-profit organizations have created many decision tools that use weather and climate data to inform nutrient application, irrigation scheduling, pest development, among other applications. They often use data (public and private) from weather stations and satellites in combination with crop production data and computer models. Many universities and state agencies contribute weather data to the National Mesonet Program for public use.



Producers use mobile devices to access data.

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Best Economic Management Practices

Economic decision making on the farm to reduce weather and climate-related risks requires both short-term actions and long-term planning. Economic Best Management Practices (BMPs) find innovative ways to increase resilience to extreme weather events in the short-term (for example, by purchasing weather insurance products), while also developing longer-term plans for adapting to the changing climate (like establishing permanent cover on highly erodible lands). Unfortunately, farmers may face economic pressures to make short-term decisions that sacrifice resiliency and delay adaptation. For example, renting agricultural lands from non-farming landowners might cause barriers for the farm operator (who does not own the land), discouraging them from investing in long-term adaptation strategies such as no-till to protect and build soil quality. USDA has developed many programs to help farmers enhance resilience to extreme weather and adapt to a changing climate.

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Crop Insurance Products

Crop insurance is the number one tool farmers use to protect themselves against the risk of weather-related losses. There are two categories of crop insurance: crop-hail insurance (designed and sold by private insurers) and multi-peril crop insurance (designed by the Federal Crop Insurance Corporation (FCIC) then sold through private approved insurance providers). Crop-hail insurance for small grains is one of the most common insurance products. Within multi-peril crop insurance products, prevented planting coverage has helped many farmers through extreme weather that made it infeasible to plant. For farmers with natural or improved perennial forage areas, the Rainfall Index (RI) Pasture, Rangeland, Forage (PRF) insurance program has helped mitigate losses associated with precipitation shortfalls.

Annual waterways provide a great way to reduce soil erosion. Photo courtesy of Tyler Williams, University of Nebraska

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Public-Private Partnerships in Crop Insurance

The USDA Risk Management Agency (RMA) acts on behalf of the Federal Crop Insurance Corporation (FCIC) to provide a variety of crop insurance products. These products are sold and serviced by Approved Insurance Providers (AIP), which RMA then backs through reinsurance agreements. Selection of an AIP who is knowledgeable of FCIC programs and up-to-date on RMA policies is important, as these programs and policies are complex and change frequently. The RMA website provides an AIP-locator tool, as well as risk management and mitigation resources for farmers and other interested individuals.

Damaged solar panel due to hail in south central Nebraska.. Photo courtesy of Tyler Williams, University of Nebraska

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Other USDA Programs

On December 20, 2018, the 2018 Farm Bill was enacted providing support for farmers, ranchers, and forest stewards through a variety of safety-net, farm loan, conservation, and disaster assistance programs.

ARC/PLC

The Agriculture Risk Coverage (ARC) and Price Loss Coverage (PLC) provide a safety net for producers producing covered agricultural commodities and who enroll in such programs. The programs provide income support to eligible producers in the case of crop revenue or crop prices below certain thresholds.

CRP

The Conservation Reserve Program (CRP) is a land conservation program that provides a yearly rental payment for farmers who "agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality" (USDA, n.d.). This program requires an application on behalf of the landowner. Contracts are for extended periods of time, with the overall goal of protecting water quality and habitat.

Sustainable Agriculture Research and Education (SARE)

The SARE program through the USDA National Institute for Food and Agriculture offers multiple grant programs for farmers to research new practices for their farms that may be applicable on a larger scale or contribute to general knowledge. In particular, the SARE Farmer Rancher and Partnership Programs require farmer participation to be awarded.

Disaster Assistance

When farmers and their communities are adversely affected by natural disasters, USDA provides support through various disaster assistance programs. The Emergency Conservation Program (through FSA) and Emergency Watershed Protection Program (through NRCS) help repair farmland and watersheds damaged during natural disasters. When severe weather results in excess livestock deaths, farmers might be eligible for assistance through the Livestock Indemnity Program. These are just a few examples of the many disaster assistance programs USDA offers.

Flood damage on Bill Luckey Farm in Columbus, NE March 2019. USDA photo by Bill Luckey

What is the most important resource for farmers in your opinion?

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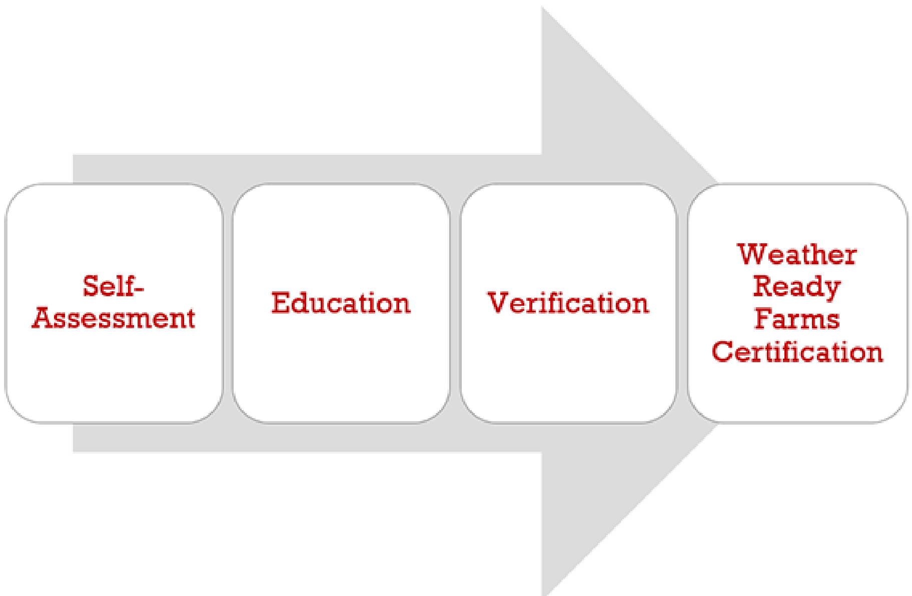
WEATHER READY FARMS OVERVIEW

This certification program can provide a model for other professionals to assist agricultural producers, communities, or even homeowners to implement practices that reduce their risk to weather and climate.

The Weather Ready Farms (WRF) certification program is through Nebraska Extension, and it can provide a model for other professionals to assist agricultural producers, communities, or even homeowners to implement practices that reduce their risk to weather and climate. The Weather Ready Farms certification program is approximately a one- or two-year program, but the length of the program is dependent on a participant's previous and current experiences implementing crop management practices related to extreme weather and climate variation. It is estimated the self-assessment and education phases take participants approximately 9-12 months to complete, and the verification and certification phases take an additional 3-12 months.

This model utilizes an initial self-assessment developed by university experts based on research-based best management practices in order to provide a snapshot of the readiness of an operation. The education phase focuses on learning about the practices needed in their operation and utilizing university resources, with a focus on continuous improvement. The verification phase is an extended phase where the applicant and person(s) providing the certification can work together on making the necessary changes to get to the certification phase. The certification phase is the final phase and the applicant receives certification once they have met all of the verification measures needed to reach full adoption of the selected level in the self-assessment. Benefits of certification can be flexible based on partners or sponsors, in addition to the benefit of reducing risk on the whole operation.

The Weather Ready Farms program can be found at https://weather-ready.unl.edu/.



Producers will work through a series of steps: Self-Assessment, Education, Verification, and Certification. Image from the Nebraska Extension Weather Ready Farms Overview (2020)

WRF Market Research

Market research is the activity or action of collecting information about consumers' needs and preferences. It's the process an entity – like a business, nonprofit, or even Extension – can use to gather important insights from the people who currently use their products or services or from people who they want to use their products or services.

Market research applies to Extension work, especially with regard to the creation and development of new programs, products, or services. Market research can provide decision-makers with important information like what learners or potential learners like or don't like about Extension programs or products, how they are using Extension services, and their attitudes about different topics such as climate change and extreme weather.

Before embarking on the development of an agricultural weather readiness program, conducting market research is an important first step. The results from the market research initiative can provide program developers with senses of clarity and direction.

WRF Self-Assessment

At the start of the program, each participant takes a self-assessment upon acceptance into the certification program. The self-assessment (see below) allows both the participant and the certification program team to: 1) understand what practices the participant is already doing to reduce the impact of climate variation and extreme weather on the farm; and 2) develop a learning plan for the participant.

The self-assessment is divided into three phases: 1, 2, and 3.

- Phase 1 encompasses introductory practices to increase farm resilience to extreme weather.
- Phase 2 includes practices that are intermediate in their approaches to increase farm resilience to extreme weather. These practices may require more time and resources to implement.
- Phase 3 includes advanced management practices that are the most time and resource intensive.

See the Nebraska Extension Weather Ready Farms Self-Assessment at https://weather-ready.unl.edu/farms

Soil moisture sensors are a great way to increase irrigation efficiency.
Photo from Tyler Williams, University of Nebraska, 2018.

WRF Education

The education phase of the certification program includes face-to-face and online teaching methods utilizing university and Extension education, and it takes place over 9-12 months. All participants will work with their WRF team contact and enroll in core education programs. Each participant enrolls in different elective programs, which are based on the participant's self-assessment and interests. An example of an individualized learning plan can be found below.

Individualized Participant Learning Plan
Example

Participant Name: *Joe Smith*	**WRF Number:**	**Initial Date:**
Certification Category: Crop Production		
People involved in setting learning plan: *Joe Smith, Ashley Mueller, Tyler Williams, and Daren Redfearn*		

Category	Target practices (SMART) *Specific, Measurable, Achievable, Realistic, and Timed*	Success Criteria	Learning Strategies	Review & Comments
2.1	Participate in a Nebraska On-Farm Research Network meeting on Feb. 18 in Grand Island or other event as it fits in schedule.	Identify a study or studies that guide at least one management decision for the 2019 growing season.	Attend the meeting and engage – ask questions and talk with others. Follow up with farmers and/or cooperating Extension faculty with questions.	☐ No ☐ Partially ☐ Fully
2.4	Schedule irrigation on a field-level basis for entire growing season by participating in online ETgage tool.	Record field-level irrigation by monitoring precipitation, evapotranspiration, and soil moisture.	Visit Nebraska Agricultural Water Management Network (NAWMN), including ETgage tool Read Extension publications related to ETgage and watermark sensors	☐ No ☐ Partially ☐ Fully
2.6	Plant cover crops in fields with excess moisture and soil runoff.	Cover crops are planted.	Attend the Nebraska Cover Crop & Soil Health Conference – ask questions and talk with others. Read Cover Crops: A Primer Use the Selector Tool to learn which selections might be best	☐ No ☐ Partially ☐ Fully

Example education plan for WRF program. Photo from draft Weather Ready Farms program (2020).

WRF Verification

In the verification phase, participants reflect on concepts learned and apply new or altered crop management strategies to reduce the impact of climate variation and extreme weather. An Extension professional, or designated person, can act as the WRF advisor and verifier to work with each participant to confirm the management strategies used on his/her farm. Verification encompasses information from the self-assessment and education phases, and this phase of the certification program is approximately three months for each participant.

The verifier will review the participant's initial self-assessment and implementation of crop management strategies at the participant's farm. The goal of the program is to identify ways in which the participant has increased on-farm resilience to extreme weather. The results will be unique to individual farmers and their farms, experiences, and decisions. Following the verification meeting, the verifier, in conjunction with the Extension project team, will determine certification status and notify the participant.

Working closely with producers and operations is a key component to the WRF program.
Photo courtesy of Vicki Jedlicka, University of Nebraska (2019)

WRF Certification

The certification phase is the final phase of the Weather Ready Farms program. For participants to achieve certification, they must demonstrate management practices that increase resilience to extreme weather. Examples include:

- If a participant's initial self-assessment mostly falls in Phase 1, certification would be awarded if the participant implements and documents Phase 2 management practices.
- If a participant's initial self-assessment mostly falls in Phase 2, certification would be awarded if the participant implements and documents Phase 3 management practices.
- In the rare event a participant's initial self-assessment mostly falls in Phase 3, certification would be awarded through an agreement of personalized management practices between the participants and the Nebraska Extension project team.

Upon notification of the certification status, the participant is recognized for accomplishments. Means of recognition may include, but are not limited to:

- Farm sign
- Feature in local or regional publications or media
- Reception or banquet
- State Ag Day ceremony

WRF Next Steps

The next steps of this developing program are to expand usage among farmers and tailor the WRF Self-Assessment to the needs of a variety of areas. We are considering an online management platform and expanding the number of educators and advisors who are familiar with the program and are able to work with producers on the Self-Assessment and Certification.

Partnerships will continue to be a key objective for expanding the use and capability of this program. These partnerships can vary based on the needs and desires of the area; however, there are many programs around the country with an interest in agricultural and environmental sustainability. There can be mutual benefit between organizations or groups to enhance, promote, and recognize the value of this Extension program. There is potential for this certification to help farmers get premium discounts on crop insurance programs or, potentially, other benefits.