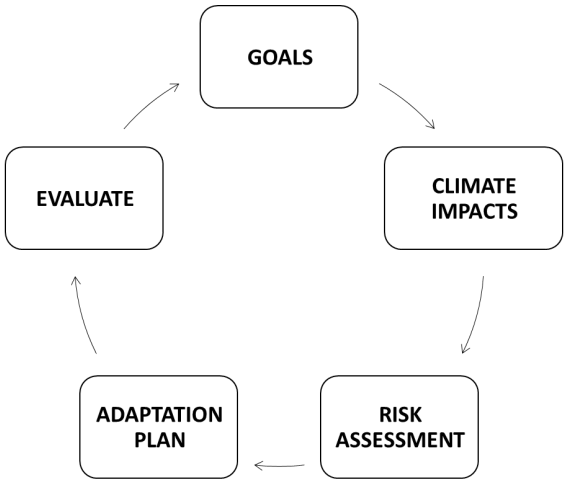
Climate Adaptation Planning for Farms

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

This worksheet was developed for farmers to develop their own plan for climate adaptation and farm resilience, knowing the unique variables of their land and operation.

Five steps for farmland climate adaptation planning:

1. Define your farm goals and priorities
2. Identify specific, observed climate impacts
3. Conduct a risk & vulnerabilities assessment based on your climate impacts and farm goals
4. Develop a set of adaptation practices
5. Evaluate the effectiveness of those adaptations practices and update your plan accordingly



This approach is adapted from Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. USDA Midwest, Northeast, and Northern Forests Climate Hubs. 2016.

1. Goals *What are the overall or immediate goals of your farm operation?*

These goals will inform your choices and priorities. Include considerations of resources, timeframe for goals, foundational values, financial requirements, etc.

Next: Assess Climate Impacts....

2. Climate Impacts

What impacts of climate change have you observed and experienced on your farm?

*Refer to pages 6 and 7 for a summary of regional observations and projections.

Changing precipitation patterns

- ☐ Wetter springs or falls
- ☐ More frequent extreme precipitation
- ☐ Saturated soils affecting planting & harvest
- ☐ Seasonal drought
- ☐ Increased need for irrigation

Increased temperatures

- ☐ Increased seasonal temperatures
- ☐ Warmer average yearly temperature
- ☐ Changing pest or disease patterns
- ☐ Increased cooling needs
- ☐ Increased weed vigor
- ☐ Animal health declines

Extreme weather

- ☐ Flooding
- ☐ Increased erosion
- ☐ Nutrient leaching
- ☐ Infrastructure damage due to wind/ snow/rain/temperatures
- ☐ Wildfire frequency or size increases

Seasonal shifts

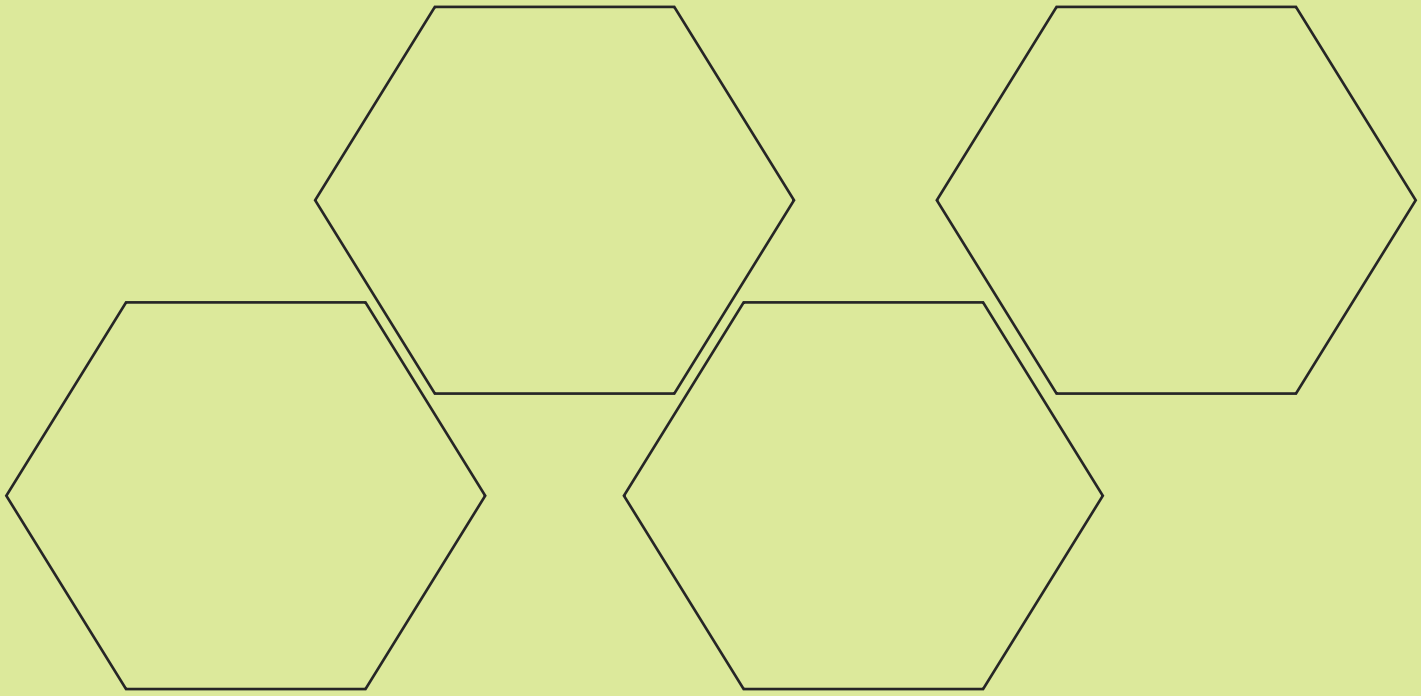
- ☐ Wetter spring/fall
- ☐ Warmer winter/summer
- ☐ Changes in timing of planting/harvest
- ☐ Crop or variety not adapted
- ☐ Pollination mismatches

Other

- ☐
- ☐

3. Risks & Vulnerabilities

Based on the observed and projected climate impacts, what are the major vulnerabilities of your farm operation? What areas of land, important crops, animals, or essential infrastructure are a priority to protect? What is at most risk? Do the identified climate impacts directly impact your top farm goals?



4. Adaptation Practices & Strategies

Review the risks and vulnerabilities section, and choose which should be addressed first. These would be immediate vulnerabilities and/or precautionary actions to prevent risk.
Once you've chosen your priorities, consider practices that could address them. Refer to the ideas on p 4. Adaptive practices should involve:

- *A reasonable timeline*
- *Flexible management that can adapt with new information*
- *"No regrets" decisions that will create broad benefits with little risk*
- *Considerations of feasibility and potential effectiveness*
- *Resources that are available and supported in your network*

Adaptation Strategies

Use these lists of strategies and practices to brain-storm, develop, and complete step 4.

Sustain fundamental functions of soil and water	Reduce existing stressors of crops and livestock	Reduce risks from warmer and drier conditions	Reduce the risk and long-term impacts of extreme weather	Manage farms and fields as part of a larger landscape	Alter management to accommodate expected future conditions	Alter agricultural systems or lands to new climate conditions	Alter infrastructure to match new and expected conditions
Maintain and improve soil health	Reduce the impacts of pests and pathogens on crops	Adjust the timing or location of on-farm activities	Reduce peak flow, runoff velocity, and soil erosion	Maintain or restore natural ecosystems	Diversify products, crops, livestock, varieties, or breeds	Minimize potential impacts following disturbance	Improve or install water systems to match demand and supply
Protect water quality	Reduce competition from weedy and invasive species	Manage crops to cope with warmer and drier conditions	Reduce severity saturated soil and flood damage	Promote biological diversity across the landscape	Diversify using new varieties, breeds, or combinations	Realign systems toward future conditions	Use structures to improve environmental control for crops
Match management practices to water supply and demand	Maintain livestock health and performance	Manage livestock to cope with warmer and drier conditions	Reduce extent of wind damage to soils and crops	Enhance landscape connectivity	Switch to commodities better suited to future conditions	Alter lands in agricultural production	Develop infrastructure to reduce animal heat stress

Content from [Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast](). USDA Midwest, Northeast, and Northern Forests Climate Hubs. 2016.

Adaptation Practices

- Cover crops to protect bare soil, cycle nutrients, fix nitrogen, etc
- Adjust nutrient application timing due to excessive rainfall
- Manage water drainage to prevent ponding, run off, erosion
- Increase irrigation capacity
- Sensors to measure water needs and applications
- Create shade for animals, crops
- Diversify crops and livestock
- Transition to perennial crops
- Improve or expand pasture
- Build soil health
- Conservation buffer strips
- Reduced tillage
- Greenhouses/ high tunnels
- Raised or permanent beds
- Trial new varieties
- Use shade cloth
- Mulch
- Irrigation expansion
- Water-bank by using less irrigation non-drought years
- Install tile drainage
- Water storage
- Optimize post-harvest cooling
- Climate controlled storage
- Shade/cooling for employees
- Convert wet cropland to riparian buffer
- Create pollinator habitat
- Manage woodlands for fire
- Prepare for smoke and poor air

5. Evaluate

Choose one or two criteria to measure the effectiveness of your climate adaptation practices. What will indicate success? How often will you take that measurement?

Use tools like the NRCS In-Field Soil Health Assessment, soil health tests, forage yields, or other data to measure success.

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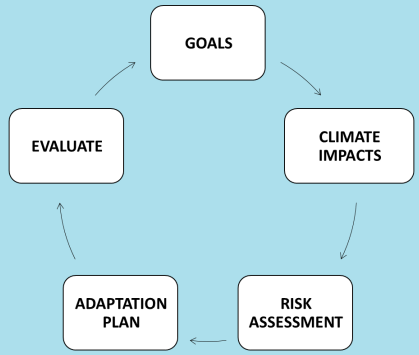


In Summary:

This climate adaptation planning cycle should be repeated over time as new practices yield results, information is gathered, and new challenges emerge.

Please see below for references and regional resources.

Primary References

- Adaptation Resources for Agriculture
- "Cultivating Climate Resilience on Farms and Ranches"
- Adaptation Resources for Agriculture: Case Studies
- Building Soils for Better Crops
- Managing Cover Crops Profitably

Websites and Organizations

- The Adaptation Workbook
- USDA Climate Hubs
- U.S. Climate Resilience Toolkit
- American Farmland Trust: Climate
- Link to find local NRCS office
- Climate Adaptation Knowledge Exchange
- Fourth National Climate Assessment
- Sustainable Agriculture Research and Education (SARE) Outreach Videos

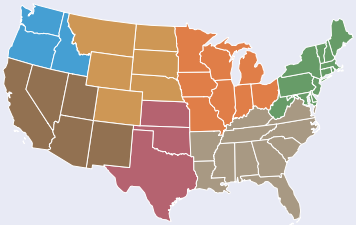
Technical Resources

- NRCS Climate Smart Conservation Practices
- SARE Ensuring Sustainable Field Crop Agriculture in the Face of a Changing Climate
- Tile Drainage Fact Sheet
- SARE Outreach videos
- Tarping in the Northeast

Regional Resources

- The Farming and Climate Change Program at the UVM Extension Center for Sustainable Agriculture
- Cornell Climate Smart Farming Program
- Quick Guide to "Climate Change and Agriculture in Vermont"
- UVM Farming & Climate Change: New England Farmers Adapt video series
- New England Adaptation Survey
- Northeast Cover Crops Decision Tool
- Midwest Cover Crop Selection Tool (Row and Vegetable Crop Tools)
- Colorado Small Acreage Irrigation Guide
- Climate Adaptation Resources for Northern New England Farmers
- California Climate and Agriculture Network (CalCAN)
- Cal-Adapt (California Climate Tool)
- Agriculture Climate Network: Climate and Agriculture Research for the Northwest

TABLE 1. Observed and Expected Changes in Weather by U.S. Region



This table is adapted from the USDA Regional Climate Hubs' Regional Agricultural Vulnerability Assessments and the National Climate Assessment 2013 National Environmental Satellite, Data, and Information Service (NESDIS) reports. Alaska and Hawaii are not included, but can be found in the Northwest and Southwest Climate Hub reports, respectively. Expected changes are the A2 scenario at

SUMMARY OF OBSERVED AND EXPECTED CHANGES	ANNUAL TEMP	ANNUAL PRECIPITATION	GROWING SEASON
NORTHWEST: Higher temps, warmer winters, more frequent and intense heatwaves, more drought and more frequent wildfires are key climate change effects. Precipitation is more variable, especially in winter. Warming winters have increased rainfall, reduced snowpack, increased risk of flooding and soil saturation, advanced the timing of spring melt and reduced summer flow in river basins fed by snowmelt. The growing season is 11 days longer. These changes are expected to continue. Summer drought and winter flooding will become more frequent.	• Greatest increase in the SE • Greatest summer increase in the interior • Greatest winter increase in SE Idaho	• Greatest increase in eastern Wash. • Decrease in central Idaho and SW Ore. • Increase in most seasons; decrease in summer	+25–35 DAYS • Greatest increase west of the Cascades
SOUTHWEST: Average temps have increased in each season, most rapidly in winter. Heat waves have increased in frequency. Variability in precipitation has increased, with major droughts in the first two decades of the 21st century. The growing season is 14 days longer. Rising temperatures and shifting precipitation patterns, especially in the southern part of the region, are expected to alter crop productivity, crop-water requirements, crop-water availability, and costs of water access.	• Less warming in coastal areas • Warming likely in all seasons, with greatest increase in summer	• Largest decrease in the Sierra Nevadas and southern Ariz. and N.M. • Largest decrease in summer in parts of Calif., Ariz. and N.M.	+10–38 DAYS • Least change in Calif. and greatest change in the interior far west
SOUTHERN GREAT PLAINS: Average annual temp has increased. Hot periods are hotter and cold periods are warmer. The growing season is six days longer. Winters and springs are wetter; summers are drier; and snowfall amounts have decreased, particularly in the eastern part of the region. Drought and extreme precipitation events are more frequent. These trends are expected to continue. The number of days over 100 degrees and nights over 80 degrees will quadruple. Heavy rains, flooding, drought and severe storms will become more frequent and intense.	• Greatest increase in the summer and fall, and least in spring	• Increase in the north and decrease in the south • Little change in spring except for a decrease in Texas	+15–30 DAYS • Greatest increase in SE Texas
NORTHERN GREAT PLAINS: Temps have risen annually and in all seasons. Northern areas warmed at the fastest rate in the nation over the 20th century. The growing season is six days longer. Winters and springs are wetter and summers drier. Snowfall has decreased, particularly in the east. Drought and extreme precipitation events are more frequent. Warming is expected to continue on average and in each season. Changes in precipitation vary by location and season, but include earlier snowmelt and stream flow runoff, a shift to more rain than snow, and snowpack declines.	• Greatest increase in winter and summer • Greatest summer increase in southwest Wyo. • Greatest winter increase in Neb. and N.D.	• Decrease in the south and increasing northward to a maximum in the NE • Greatest increase in winter and fall; greatest decrease in summer	+20–30 DAYS
MIDWEST: Higher annual temps, warmer winters and springs, and more extreme precipitation events during the growing season are key climate change effects. Annual temps have increased, with warmer winters and springs, and cooler summers. The growing season is nine days longer. Precipitation has increased, especially in spring, summer and fall. Snowfall has decreased in the south and west but has increased in the north, in Indiana and along the Great Lakes shorelines. These temperature and precipitation trends are expected to continue annually and in most seasons.	• Greatest winter increase in NW Minn. • Greatest summer increase in the south	• Greatest increase in the far north; little or no change in the south • Increase in winter, spring and fall; no change to a decrease in summer	+22–30 DAYS • Greatest increase in northern Mich.
NORTHEAST: Temps have increased annually and in each season, and total precipitation has increased, especially in fall. Rainfall intensity has increased notably, particularly in the north. More intense heavy rainfalls, milder winters, earlier spring melt and sea-level rise have increased the risk of flooding. There are more hot days, fewer cold days and more intense rain. The growing season is nine days longer. These changes are expected to continue and will vary by location and season. The frequency and intensity of flooding will increase, especially in winter and spring.	• Both annual and seasonal temps increase with latitude • Seasonal increase greatest in winter and summer; least in spring	• Greatest increase in N.J. and Del. • Seasonal increase greatest in winter • Summer precipitation expected to decline	+19–27 DAYS
SOUTHEAST: Annual and seasonal temps have steadily increased since the 1970s, particularly in summer in coastal regions, while winter temps have generally cooled over the same areas. The length of the growing season is unchanged. Seasonal precipitation patterns are changing, with the greatest changes in fall (increase) and summer (decrease). Average annual snowfall has declined. Average temps and precipitation are expected to increase; however, the rate of change will vary with location and season.	• Greatest change in the NW; least in the SE • Seasonal increase greatest in summer, especially in the NW	• Greatest increase in winter • Summer precipitation increases or decreases depending on area	+0–30 DAYS • Least change in southern Fla. • Greatest change in the north and in southern La. and Ala.

mid-century (2041–2070 average). Definitions of terms: growing season–the period between the last occurrence of 32° in the spring and first occurrence of 32° in the fall; hot days–annual average of days with max temp exceeding 95°; hot spells–max number of consecutive days with max temps over 95°; cold days–average annual number of days with min temp below 10°; freeze days–days with a min temp below 32°; wet days–average annual number of days with precipitation over 1 inch; dry spells–max number of consecutive days with less than 0.1 inch of precipitation; heat and cold wave–a four-day period that is hotter and colder, respectively, than the threshold for a one-in-five-year recurrence for the region; extreme precipitation–the occurrence of one-day, one-in-five-year extreme precipitation for the region.

HOT DAYS	HOT SPELLS	COLD DAYS	FREEZE DAYS	WET DAYS	DRY SPELLS
+10 DAYS • Greatest increase in the SE	**+6–10 DAYS** • Greatest increase in southern Idaho	**-10–30 DAYS** • Greatest decrease in inland regions • Little or no decrease in coastal regions	**-30–40 DAYS** • Greatest change at high elevations	⇧ • Greatest increase in eastern Wash. and Ore., and northern Idaho	**+9–15 DAYS** • Greatest increase in western Ore.
+5–20 DAYS • Least change at high elevations and greatest change in the south and east	**+8–16 DAYS** • Increase of 20 days or more in the south	**-0–25 DAYS** • No change in the south • Greatest change at higher elevations in the interior north	**-25–35 DAYS** • Greatest change at high elevations • Little change in coastal areas and southern Calif. and Ariz.	⇧ • Increase, except for a decrease in eastern Colo., Ariz. and the Sierra Nevadas	**+15–25 DAYS** • Greatest increase in dry areas of Nevada, Arizona and California
+20–30 DAYS • Greatest increase in SW Texas	**+8–24 DAYS** • Greatest increase in northern Texas and Okla.	**-0–10 DAYS** • Greatest decrease in the north	**-0–20 DAYS** • Greatest decrease in the west	**NO CHANGE**	⇧ ⇩ • Decrease by up to three days in Neb. • Increase by 6–15 days in most of Okla. and Texas
+0–20 DAYS • Greatest increase in SW Neb.	**+0–12 DAYS** • Greatest increase in the south	**-10–25 DAYS** • Greatest decrease in southern Mont. and western Wyo.	**-15–21 DAYS** • Greatest decrease expected in the northwest	**NO CHANGE**	⇧ ⇩ • Decrease in the north by as much as six days • Increase in the west by up to 15 days
+5–30 DAYS • Change increases moving south	**+5–20 DAYS** • Change increases moving south	**-10–25 DAYS** • Greatest change in the NW • Least change in the south	**-18–23 DAYS** • Greatest decrease in the east	⇧ • Greatest increase in the states bordering Canada	**+0–8 DAYS** • Greatest increase in the north • A slight increase in the south
+3–21 DAYS • Greatest change in parts of W.Va. and Md. • Least change in the region's northernmost areas	**+1–7 DAYS** • Greatest change in W.Va. • Least change in N.Y. and New England	**-6–24 DAYS** • Greatest change in the north • Least change in the south	**-18–26 DAYS** • Smaller changes likely along parts of the Atlantic coast	⇧ • Greatest increase in NW N.Y. and northern Maine	**NO CHANGE**
+4–35 DAYS • Least change in the Appalachians • Greatest change in south central Fla.	**+4–20 DAYS** • Least change in the Appalachians • Greatest change in the west	⇩	**-0–25 DAYS** • No change in southern Fla. • Change increases moving north	⇧ • Greatest increase in the Appalachians	**-0–25 DAYS** • Greatest change along the Gulf Coast • No change elsewhere