

# Farms Under Threat 2040 Climate Projections Point to Future Challenges for Rainfed Cropping Systems

oday's climate is not the new normal—change itself is the new normal. For agriculture, this means that growing seasons are more unpredictable, rains are spotty yet sometimes come all at once, and crops and livestock are facing more consecutive dry days and hotter nights. It is now even harder for farmers and ranchers to do what they do best—steward the land and keep the rest of us clothed and fed. American Farmland Trust (AFT) looked at how changes in future climate conditions might impact rainfed crop production across the U.S. More details are available in the accompanying web mapping tool, AFT's climate modeling paper, the technical modeling report, and AFT's brief overview of adaptation strategies at <u>development2040.farmland.org/ClimateImpact</u>.

## Changing weather conditions will put some of our rainfed agricultural production at risk.

Over 80% of croplands in the contiguous United States depend on timely and predictable rainfall to stay in production. To better understand how future growing conditions might change and where impacts may be the greatest, AFT and our partners modeled how likely it is that the use of present-day varieties and production practices will continue to be feasible by 2040 for rainfed croplands in general, and for grain corn, winter wheat, and the combined rainfed and irrigated acres of apples under two potential scenarios for future greenhouse gas (GHG) emissions. We modeled: 1) a high-emissions trajectory (the path we're currently on) and 2) a low-emissions trajectory which assumes that we take immediate climate action to significantly reduce GHG emissions by 2030. To visualize potential shifts, we first calculated the average likelihood of cultivation for cropland, corn, winter wheat, and apple acreage in 2016 to establish a baseline. We then compared the projected likelihood of cultivation in 2040 to the 2016 average. For areas with below average likelihood of cultivation in 2040, employing present day crop varieties and production practices may become increasingly difficult.

#### The use of present-day crop varieties and production practices may become increasingly challenging in certain places.

Figure 1 shows the percent of rainfed cropland, corn, winter wheat, and apple acres in 2040 that are now above or below the 2016 average likelihood of cultivation under the two contrasting climate trajectories we assessed. Acres where present-day crop varieties and production practices will be less viable are shown in shades of red. Although the climatic conditions improve for a small percent of acres (dark green) and present an increased opportunity for cultivation, many



**Figure 1.** Changes in rainfed growing conditions by 2040. This figure shows how the likelihood of cultivation will change by 2040 relative to the 2016 average. Below this baseline, the use of present-day varieties and production practices will be much more difficult. The acres where likelihood of cultivation remains above the 2016 average in 2040 are shown in light green while acres that remain below the 2016 average in 2040 are shown in light red. A small percentage of acres move above the 2016 baseline (dark green) in 2040, denoting increased opportunity for cultivation, while a significant percentage of acres move below this baseline (dark red) indicating increased threat. Irrigated acres were not mapped and are not shown.



more acres will experience less favorable conditions in 2040. These areas face increased threat as they become less suitable for production and the likelihood of cultivation diminishes (dark red). This is particularly true for apple production. For both climate trajectories, changing weather conditions will make farming more difficult but immediate climate action may limit the need for farmers to transition to new crops.

#### Projected declines in growing conditions for corn, the most extensive rainfed crop in the U.S., are widespread.

Our research shows changes

in the likelihood of cultivation by 2040 for corn, winter wheat, apples, and cropland in general. For example, the map of projected corn acreage in 2040 (Figure 2) shows the shifts in

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opportunities for, and threats to, the cultivation of corn for grain. Corn can grow almost anywhere but has been especially well-suited to the Midwest due to its moderate temperatures, sufficient rainfall, soil types, and supporting infrastructure (e.g., storage and processing facilities, farm equipment, and

hauling capabilities). On a high-emissions trajectory, only 33% of corn acres in 2040 are likely to remain highly productive with the current management practices. In contrast, immediate climate action keeps almost 50% of the corn acres above the 2016 average. Until now, continual improvements in corn hybrids and other agricultural technologies have been able to maintain increases in corn yields but corn is uniquely sensitive to hotter temperatures and water stress-conditions that will occur more frequently in a warmer and drier climate.

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### Why some rainfed croplands and other essential croplands are not included in our maps

This analysis focuses on how future climatic conditions could impact rainfed cropland, not irrigated cropland. Due to difficulties in separating irrigated acres from rainfed acres, counties where over 50% of the cropland is irrigated were removed from the analysis although rainfed cropland may be present in these counties as well. These counties are shown in dark grey on our maps. Although not included in our analysis, irrigated agriculture is an essential part of the American food system. Only 14% of U.S. croplands are irrigated but they account for more than 54% of the total value of U.S. crop sales, including over 70% of vegetables and 80% of fruits and nuts. States with a high proportion of irrigated cropland include California (73%), Nevada (61%), Wyoming (55%), Idaho (51%), Utah (48%), Nebraska (46%), and Arizona (45%). Warmer temperatures and shifting rainfall patterns will affect the availability of both surface and groundwater used for irrigation. By 2040, nearly half of the water basins in the U.S. could experience high or extremely high water stress due to declining supply and increasing demands. Rainfed cropland may also feel the effects of dwindling surface and groundwater supplies. The use of supplemental irrigation on rainfed croplands helps increase available soil moisture in some areas and provides a critical buffer during periodic droughts. Although projected changes in climate conditions may make it less likely that farmers can continue to grow current crop varieties in certain areas using present-day production practices by 2040, taking immediate climate action limits the percent of acres that may face increased threat. This result takes on added significance since our analysis only covers how changes in average temperatures and rainfall interact with soils and terrain to impact likelihood of cultivation. Future crop production will likely face more frequent extreme weather events like destructive winds, hail, frost damage, droughts, extended heat waves, and torrential downpours, as well as increased damage due to crop pests and diseases. These

extreme events will occur more often if we stay on a high-emissions climate trajectory.

#### There is hope.

The quickest ways to address the build-up of carbon dioxide in the atmosphere are to reduce emissions and remove existing atmospheric carbon dioxide. And while all sectors have a role to play in solving the climate crisis, agriculture is a sector that can contribute to both reductions and removal. Practices like planting cover crops, adopting zero or reduced tillage, and diversifying crop rotations can improve the soil's physical and biological functions and its ability to sequester carbon. Croplands managed for soil health are more resilient to a changing climate; they are less vulnerable to erosion, have increased water-holding capacity during drought, support crop yield stability, and—in many cases sequester carbon.

### We can limit warming AND increase the resiliency and profitability of agricultural lands.

The best window of opportunity to change the trajectory of the changing climate and avoid compounding impacts is NOW and, with the right tools and support, agricultural producers can adapt to and help reverse these trends.

AFT's 2023 Farm Bill policy recommendations are designed

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to help farmers build resilience while mitigating and adapting to the current impacts of climate change. Actions include improvements to the Conservation Title (Title II) Programs and the Crop Insurance Title (Title XI) Program to build on-farm resilience and reduce risk (e.g., offering crop insurance discounts for risk-mitigating practices like cover crops), and the creation of a new federal match to bolster emerging innovative state soil health programs. State and local governments also have critical roles to play in taking actions to reduce GHG emissions and supporting farmers and ranchers in being a part of the climate solution. Implementing these recommendations will improve our chances of limiting warming, and in the process, make agricultural land and businesses more economically and environmentally resilient.



**FARMS UNDER THREAT** is American Farmland Trust's multi-year initiative to document the status of and threats to U.S. farmland and ranchland and to identify policy solutions to protect and conserve America's diverse agricultural landscape. For questions and to access the data, please contact AFT's Farmland Information Center at **farmlandinfo.org** or (800) 370-4879.



Explore our interactive maps and read the full report at farmland.org/farmsunderthreat.

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