AGRICULTURE

Climate disruptions to agriculture have been increasing and are projected to become more severe over this century.

Some areas are already experiencing climate-related disruptions, particularly due to extreme weather events. While some U.S. regions and some types of agricultural production will be relatively resilient to climate change over the next 25 years or so, others will increasingly suffer from stresses due to extreme heat, drought, disease, and heavy downpours. From mid-century on, climate change is projected to have more negative impacts on crops and livestock across the country – a trend that could diminish the security of our food supply.

Key Messages

Climate disruptions to agricultural production have increased in the past 40 years and are projected to increase over the next 25 years. By mid-century and beyond, these impacts will be increasingly negative on most crops and livestock.

Many agricultural regions will experience declines in crop and livestock production from increased stress due to weeds, diseases, insect pests, and other climate change induced stresses.

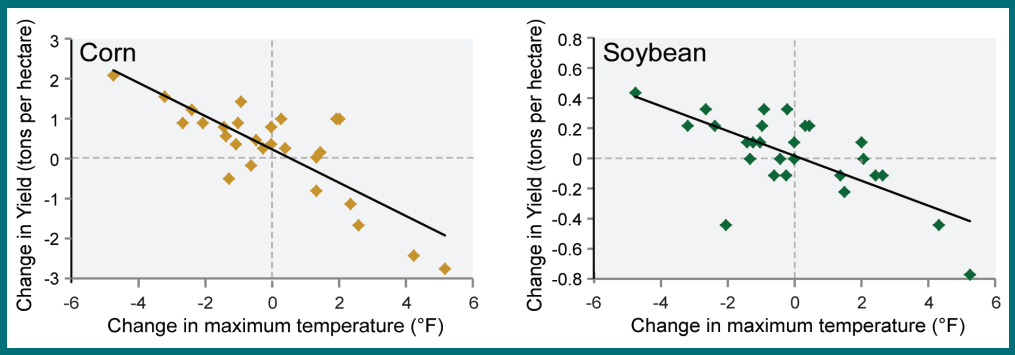
Current loss and degradation of critical agricultural soil and water assets due to increasing extremes in precipitation will continue to challenge both rainfed and irrigated agriculture unless innovative conservation methods are implemented.

The rising incidence of weather extremes will have increasingly negative impacts on crop and livestock productivity because critical thresholds are already being exceeded.

Agriculture has been able to adapt to recent changes in climate; however, increased innovation will be needed to ensure the rate of adaptation of agriculture and the associated socioeconomic system can keep pace with climate change over the next 25 years.

Climate change effects on agriculture will have consequences for food security, both in the U.S. and globally, through changes in crop yields and food prices and effects on food processing, storage, transportation, and retailing. Adaptation measures can help delay and reduce some of these impacts.

Crop Yields Decline under Higher Temperatures



Crop yields are very sensitive to temperature and rainfall. They are especially sensitive to high temperatures during the pollination and grain-filling period. For example, corn (left) and soybean (right) harvests in Illinois and Indiana, two major producers, were lower in years with average maximum summer (June, July, and August) temperatures that were higher than the 1980-2007 average. Most years with below-average yields are both warmer and drier than normal.[1,2] There is a very high correlation between warm and dry conditions during Midwest summers[3] due to similar meteorological conditions and drought-caused changes[4] in the surface. (Figure source: redrawn from Mishra and Cherkauer 2010[1]).

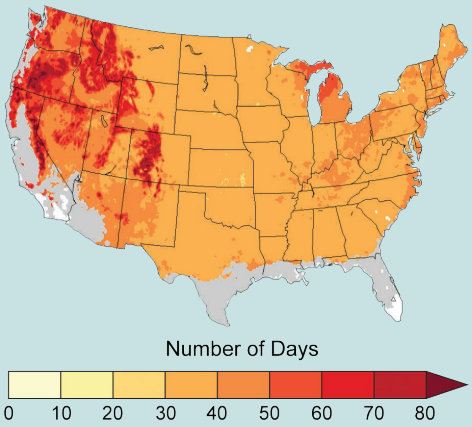
Climate change poses a major challenge to U.S. agriculture, because of the critical dependence of the agricultural system on climate and because of the complex role agriculture plays in social and economic systems. Climate change has the potential to both positively and negatively affect the location, timing, and productivity of crop, livestock, and fishery systems at local, national, and global scales.

The U.S. produces nearly $330 billion per year in agricultural commodities.[5] This productivity is vulnerable to direct impacts on crop and livestock development and yield from changing climate conditions and extreme weather events, and indirect impacts through increasing pressures from pests and pathogens. Climate change has the potential to both positively and negatively affect agricultural systems at local, national, and global scales. Climate change will also alter the stability of food supplies and create new food security challenges for the U.S. as the world seeks to feed nine billion people by 2050.

The agricultural sector continually adapts through a variety of strategies that have allowed previous agricultural production to increase, as evidenced by the continued growth in production and efficiency across the United States. However, the magnitude of climate change projected for this century and beyond, particularly under higher emissions scenarios, will challenge the ability of the agriculture sector to continue to successfully adapt.

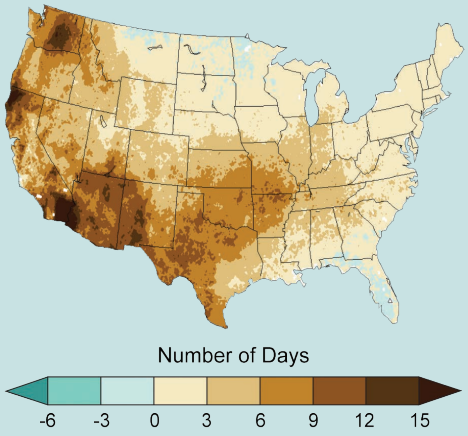
Key Climate Variables Affecting Agricultural Productivity

Change in Frost-Free Season Length



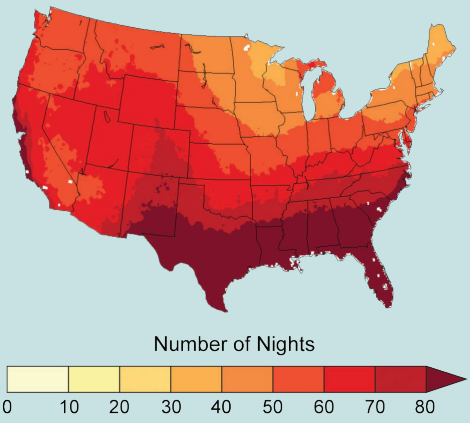
Frost-free season is projected to lengthen across much of the nation. Taking advantage of the increasing length of the growing season and changing planting dates could allow planting of more diverse crop rotations, which can be an effective adaptation strategy.

Change in Number of Consecutive Dry Days



The annual maximum number of consecutive dry days (less than 0.01 inches of rain) is projected to increase, especially in the western and southern parts of the nation, negatively affecting crop and animal production. The trend toward more consecutive dry days and higher temperatures will increase evaporation and add stress to limited water resources, affecting irrigation and other water uses.[6]

Change in Number of Hot Nights



Hot nights are defined as nights with a minimum temperature higher than 98% of the minimum temperatures between 1971 and 2000. Such nights are projected to increase throughout the nation. High nighttime temperatures can reduce grain yields and increase stress on animals, resulting in reduced rates of meat, milk, and egg production.[7]

Projections are shown for 2070-2099 as compared to 1971-2000 under an emissions scenario that assumes continued increases in heat-trapping gases (A2). (Figure source: NOAA NCDC / CICS-NC).