

Climate Change and Famine

Climate change is already threatening the Earth's ability to produce food. These effects are expected to worsen as climate change worsens. Estimates vary, but for every 1.8°F increase in global average surface temperature, we can expect about a 10% decline in yields of the world's major grain crops—corn, soybean, rice and wheat^{1,2} Climate experts predict that global temperature may rise as much as 5.4°F to 9°F if we continue burning fossil fuels at our current rate.³ This could lead to 30% to 50% declines in crop production.¹ Already, one in seven people, including many living in the U.S., is hungry every day.⁴

Most models only consider the effect of rising temperatures and carbon dioxide (CO₂) levels on crop growth, and thus represent relatively conservative scenarios. Climate change will disrupt food production and distribution in other ways that are hard to quantify and include in prediction models, such as:

- ▶ More droughts causing large-scale crop loss
- ▶ Increasing frequent, severe, and longer-lasting heat waves killing crops
- ▶ Thriving plant pests and diseases destroying crops

- ▶ Heavy rains and storms flooding fields, eroding soils and washing away crops
- ▶ Melting glaciers and changing river flows reducing water availability for irrigation
- ▶ Rising sea levels and storm surges flooding crops and salting soils
- ▶ Higher ozone levels damaging plants and reducing crop yields

Specific climate change impacts

RISING TEMPERATURES: The effects of warmer temperatures on crop production will vary by region and crop, but almost all estimates indicate eventual reduced overall crop yields.^{1,5} Higher temperatures decrease rates of photosynthesis, reduce soil moisture, increase water demand and lead to increased survival of plant pests, diseases and weeds—all of which combine to reduce final yields.^{1,5,6,7}

INCREASING CO₂: In certain plants, like wheat, soybeans and rice, higher CO₂ levels actually increase



Thirty percent of Russia's wheat crop was lost to fire 2010.



Climate change will disrupt food production and distribution.

growth by the “CO₂ fertilization effect”.^{1,2,6} Higher CO₂ levels increase photosynthesis and reduce plant water loss.^{1,5,6} However most experts agree that the CO₂-related benefits on some crops will be outweighed by other negative effects of climate change as global temperatures continue to rise.^{2,8,9}

INCREASING TEMPERATURE EXTREMES: An increase in the number of days of extreme heat leads to large declines in crop yields, especially when they occur during key stages of plant development such as flowering and grain-filling.^{1,5,19} Extreme heat damages photosynthetic and reproductive cells, causing decreased growth and sterility, and can decrease grain quality.^{5,6,10,11}

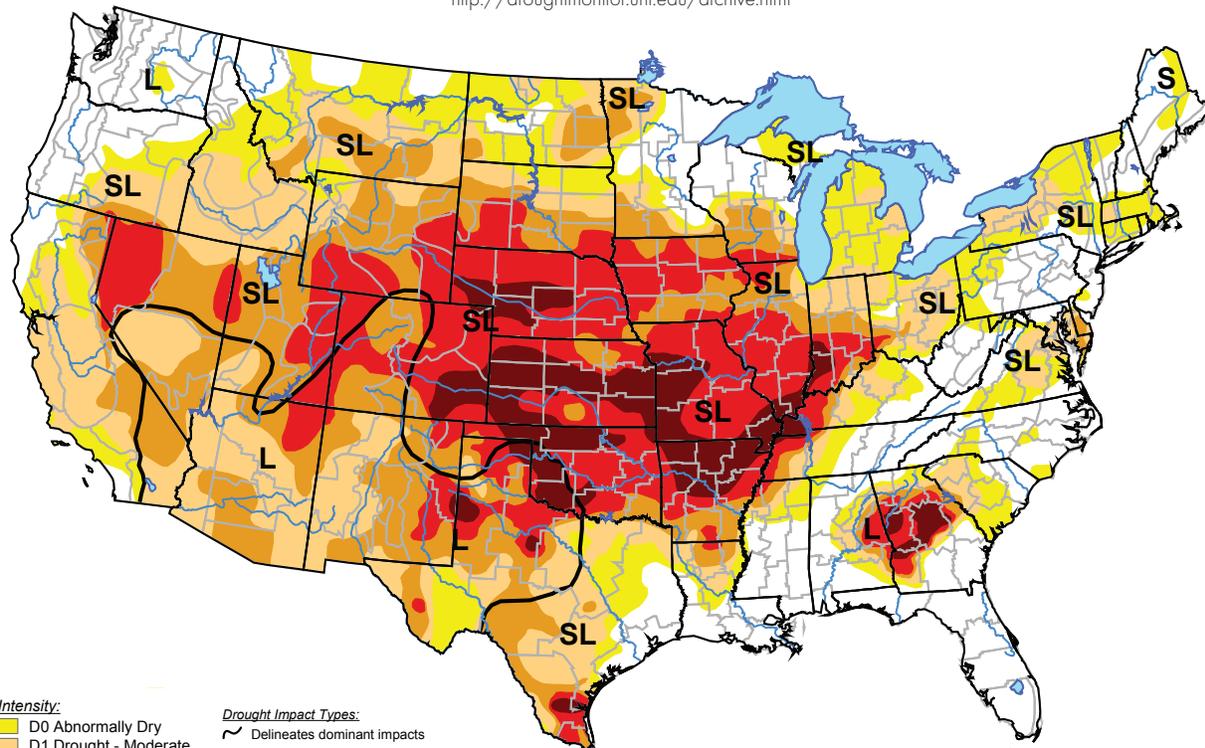
INCREASING DROUGHT: Climate change will cause more frequent, severe and long-lasting droughts. Many of the largest crop losses in history can be attributed to drought and it is the main cause of year-to-year

variations in yields.^{5,10} Eighty percent of agriculture is rain-fed and especially susceptible to drought,⁵ but even irrigated agriculture is threatened by drought as stored water supplies are depleted.¹⁰ The area of land producing major crops (corn, rice, soy, wheat, sorghum and barley) affected by drought has risen from 5–10% in the 1960s to 15–25% today.¹²

HEAVY RAINS, FLOODS AND TROPICAL STORMS: Extreme rainfall events and intensity of tropical storms is increasing.⁵ Rainfall intensity could increase by 25% in many agricultural areas.⁵ Heavy rainfalls reduce crop productivity by a number of mechanisms. Flooding wipes out vast areas of crops and damages others. In Bangladesh in 2007, cyclone Sidr damaged 1.6 million acres of cropland and over 25% of the rice crop.¹³ Heavy rains also cause significant soil erosion reducing long-term productivity. Waterlogged soils reduce plant growth and increase fungal diseases.^{5,6} Farming operations are often delayed when soils

U.S. Drought Monitor

<http://droughtmonitor.unl.edu/archive.html>



Intensity:
 D0 Abnormally Dry
 D1 Drought - Moderate
 D2 Drought - Severe
 D3 Drought - Extreme
 D4 Drought - Exceptional

Drought Impact Types:
 ~ Delineates dominant impacts
 S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
 L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



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Fifty percent of cropland had significant drought in 2012.

are too wet for heavy machinery and flooding can destroy farming supplies, machinery and other infrastructure.⁵ Finally, coastal storm surges contribute to soil salinization making widespread areas unfit for planting.⁵

MELTING GLACIERS AND CHANGING RIVER

FLOWS: Glaciers are a critical water supply for drinking and irrigation but the majority of the world's glaciers are shrinking.¹⁴ Glacier runoff provides water through the year where rainfall is limited, allowing irrigation during dry seasons.⁵ Receding glaciers threaten large rivers, such as the Ganges, Indus and Brahmaputra in India, on which over 500 million people depend, to become seasonal—devastating regional agriculture if adaptations are not made.^{5,15}

SEA LEVEL RISE: As sea levels rise, low-lying coastal agriculture in major river deltas and small island nations is especially vulnerable.⁵ Rising seas and storm surges will inundate agricultural lands, and salinization of soils and aquifers will threaten agriculture.⁵

PESTS AND DISEASES: Many crop pests, such as aphids and weevils, grow better and live in a wider range of areas in warmer temperatures and higher CO₂ levels.⁵ Changes in climate also shift the geographic range and frequency of crop diseases, altering the predictability of outbreaks.^{2,5,17} Environmental stresses may cause mutations in crop diseases that increase their destructiveness. Heat and water stress reduce crop resistance to pests and diseases.⁵

WEEDS: Certain invasive weeds, such as privet and kudzu in the United States, benefit from increasing temperatures and CO₂ levels more than crops.¹⁷ There is evidence that herbicides may lose effectiveness at elevated CO₂ levels.¹⁷ As increasing amounts of herbicide are required to maintain productivity, significant economic, environmental and health costs will result.¹⁷

INCREASING OZONE: Ground-level ozone is a major air pollutant that results from burning fossil fuels.⁹ Ozone inhibits photosynthesis and stunts plant growth.^{5,6,9} Current ozone levels are already suppressing yields of many crops (alfalfa, beans, peanut, potato, rice, soy and wheat) and these effects will worsen as ozone levels continue to rise.⁹



Corn crop under water

Conclusion

Farmers are resilient and frequently adapt to changes in weather. However, climate change will create conditions outside of human experience, challenging farmers' ability to adapt.⁵ While farmers with more wealth and resources are more likely to be able to adapt to a changing climate through investments in new technologies, seed varieties and cropping patterns, poorer subsistence farmers will be less likely to adapt and are thus more vulnerable.^{1,2,6} Regardless of wealth, complete adaptation is not possible.

Increasing extreme weather events has the potential to devastate infrastructure of the entire food system.¹⁰ Storms and flooding can destroy food processing, packaging and storage facilities and disrupt transportation infrastructure such as roads, bridges, railways, airports and shipping routes preventing available food from getting to where it is needed.^{10,17}

Though this fact sheet focuses on agricultural crops, they are only one part of the food supply. The changing climate also affects animal production. Decreasing supply and increasing prices of feed grains will increase the price of meat.^{1,9} Temperature extremes will increase animal deaths and the cost of cooling animal facilities.^{1,9} Rising temperatures and changing rainfall patterns will alter the distribution of animal diseases such as anthrax and blackleg, potentially reducing production.⁹ The overall impact on fisheries is uncertain, however a 40% catch decline is expected in the tropics as commercial species move north out of warming waters.¹

Food prices will rise as climate change reduces the amount of food available. And people get angry, even violent, when food becomes more expensive.

In 2008, world wheat, rice, corn and soybean prices tripled.¹⁸ Food riots erupted across Egypt, Yemen, Morocco, Cameroon, Senegal, Ethiopia, Haiti, Indonesia, Mexico, and the Philippines.¹⁸ Social order unraveled as armed Thai villagers guarded their rice fields against rice rustlers; grain trucks were hijacked in Sudanese refugee camps; Pakistani troops had to guard grain elevators and wheat trucks.¹⁸ There is concern about increased conflict and violence as food supplies constrict.

Already one billion people in the world go hungry every day—that's one in every seven people.¹⁸ Every year one third of child deaths are caused in part by under-nutrition.¹⁹ World population continues to grow and is expected to reach 9 billion by 2050.²⁰ To feed this many people and their rising demand for animal products, overall food production must rise by 70% from 2005–07 levels.²⁰ But a 5°F to 9°F rise in global average temperature could reduce grain yields by 30% to 50%, and global food supplies even more. The combination of decreasing food production in the face of increasing food demand would likely lead to widespread social unrest and hunger—even catastrophic global famine.

This is the future that awaits us if we fail to act. But we can rewrite the future from this grim view IF we work to create many solutions, from efficiencies to new renewable energy, to reduce greenhouse gas emissions by 80% by 2050. To find out how you can get involved in making a better future, visit [WWW.PSR.ORG](http://www.psr.org) to discover actions going on in your area.

Endnotes

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