

## Study Finds Climate Change May Dramatically Reduce Wheat Production

A recent study involving Kansas State University researchers finds that in the coming decades at least one-quarter of the world's wheat production will be lost to extreme weather from climate change if no adaptive measures are taken.

Vara Prasad, professor of crop ecophysiology and director of the USAID Feed the Future Sustainable Intensification Innovation Lab at Kansas State University, is part of a collaborative team that found wheat yields are projected to decrease by 6 percent for each degree Celsius the temperature rises if no measures to adapt to extreme weather fluctuations are taken. Based on the 2012-2013 wheat harvest of 701 million tons worldwide, the resulting temperature increase would result in 42 million tons less produced wheat — or a loss of nearly one-quarter of the current wheat production.

"It's pretty severe," Prasad said. "The projected effect of climate change on wheat is more than what has been forecast. That's challenging because the world will have to at least double our food supply in the next 30 years if we're going to feed 9.6 billion people."

Prasad and colleagues published their study, "Rising temperatures reduce global wheat production," in a recent issue of the scientific journal *Nature Climate Change*. The study was supported through the Kansas Wheat Commission and the Kansas Wheat Alliance, two organizations seeking ways to increase wheat yield.

For the study, researchers systematically tested 30 wheat crop models against field experiments from around the world that were conducted in areas where the average temperature of the growing season ranged from 15 to 32 degrees Celsius. The models accounted for planting dates, planting rates, temperatures and other crop management factors.

With the models, researchers were able to look at the effects of temperature stresses on wheat and predict future changes based on temperature changes.

Researchers found that the effects from climate change and its increasing temperatures on wheat will be more severe than once projected and are happening sooner than expected. While Prasad said increases in the average temperature are problematic, a bigger challenge is the extreme temperatures that are resulting from climate change.

"Extreme temperature doesn't only mean heat; it also means cold," Prasad said. "Simply looking at the average temperature doesn't really show us anything because it's the extremities that are more detrimental to crops. Plants can handle gradual changes because they have time to adapt, but an extreme heat wave or cold snap can kill a plant because that adjustment period is often nonexistent."

Researchers also found that increasing temperatures are shortening the time frame that wheat plants have to mature and produce full heads for harvest, resulting in less grain produced from each plant.

"It's like having one minute to fill a tall glass with water. Under optimal conditions, we can fill that glass pretty well," Prasad said. "But now we're factoring in extreme temperatures that are affecting

the growing window and the grain size. So it becomes like trying to fill that same glass, but now we only have 40 seconds to do it and the faucet is running slower."

Currently, Prasad and colleagues at Kansas State University, in collaboration with the university's Wheat Genetics Resource Center, are using growth chambers and heat tents to quantify the effects of temperature. The data will help in refining the crop models so that they can be more accurate in predicting wheat responses.

Their work will help scientists develop more robust models that can help farmers globally select more weather-tolerant and resilient wheat varieties based on their location. Additionally, farmers can determine the optimal planting date to avoid stress and minimize possible exposure to extreme weather events, such as heat and cold snaps, during the growing season.

Kansas is the No. 1 wheat-producing state in the U.S., growing 9.4 million acres of wheat in 2014.