

Managing Agriculture in a Climate of Change

Global warming and climate change are accepted as facts. Now, in addition to our research on mitigating greenhouse gas emissions and other factors involving agriculture and forestry, ARS is increasingly focused on finding ways for agricultural systems to adapt to this change.

The key to agriculture's successful adaptation is providing producers and land managers with decision-support technologies and improving the resilience of agro-ecosystems. Diversifying farm operations with a mix of crops and livestock that can thrive under changing environments is one major way to add resilience.

Other adaptations will involve new farm and ranch management techniques as well as increased adoption of technologies already shown to enhance sustainability and resilience.

We have to rethink everything from top to bottom to respond to the changes we face today and in the future. We need to look at plant and animal breeding; soil management; fertilizer practices; and management strategies for weeds, diseases, and insects.

Several ARS scientists contributed to scientific reports that earned the Intergovernmental Panel on Climate Change the Nobel Peace Prize for 2007, shared with former Vice President Al Gore. And many scientists mentioned in this issue of *Agricultural Research* are authors of or references in the U.S. Climate Change Science Program (CCSP) May 2008 report titled "The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States."

The U.S. Department of Agriculture, as one of the 13 federal agencies whose global change research is coordinated by the CCSP, was the lead agency for this report. It is one of a series of reports published by the CCSP—all online at www.gcrio.org/library/sap-final-reports.htm—on various aspects of climate change, covering topics from adaptation options to temperature trends to the carbon cycle to effects on energy use, transportation, and human health.

The report states that today's average CO₂ level of 380 parts per million is projected to rise to 440 ppm around 2038, with average temperatures rising 2°F. The article on page 14 of this issue of *Agricultural Research* suggests that these future conditions may already be taking place in urban "heat islands," such as the one in Baltimore, Maryland. If this is true, these areas could give us a glimpse into future effects on plant community health and composition.

The article also points out that global warming's gradual effects on western rangelands over the past century may have been masked by similar effects of overgrazing. Rangeland responses to these effects may have been one of the earliest warnings of changes to come, but its significance has been missed until recently. ARS scientists are suggesting that both climate change and overgrazing may have been driving the extensive degradation of western rangelands.



Both overgrazing and climate change, which includes increasing atmospheric carbon dioxide, and changing patterns of air temperatures and precipitation, are part of what we call "global change." The term refers to all changes or disturbances, both human caused and naturally occurring, that can affect the planet. ARS's focus, of course, is on the effects on agriculture and on the natural resources, such as soil, needed to sustain agricultural productivity and ecosystem services.

In addition to overgrazing, human causes of global change include other land-use changes—deforestation, fires, and urban development—and burning of fossil fuels.

The story on page 14 also suggests that people may have a bigger role in global change, beyond that of global warming, than previously thought. And there is evidence that fast-growing invasive weeds are selectively favored by global change.

This research helps us tease out the various strands of the complex interactions between changes of climate, land use, and species invasion.

There are many aspects of global change, and there is a mix of positive and negative effects. The evidence at hand shows us that today's ecosystems are being pushed to the limit, and few would ever wish such a stress test on the planet. The CCSP's "Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources" report says that reducing human-made stresses, such as pollution, is the most certain adaptation to improve any ecosystem's resilience.

At ARS, we continue to conduct scientific experiments and computer modeling to help farmers, ranchers, and agribusiness in general adapt to many rapid changes—and to help them use flexible management techniques to slow or reverse the changes by reducing greenhouse gas emissions and other environmental stressors. We work with other federal agencies and universities to ensure that the scientific knowledge gained from our agricultural research helps frame both the national and international debate on ways to deal with global change.

As the CCSP's "Adaptation Options" report concludes, "decision-making processes could be streamlined so that management approaches do not stand still while climate change proceeds rapidly."

ARS global change research seeks to enable better decisions by producers, land managers, agribusinesses and strategic decision makers to mitigate the effect of agriculture on climate and to enable agriculture to adapt to the changing climate.

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