GLOBAL CHANGE What Will It Do to Agriculture?

Climate has changed tremendously over geologic time. Even during the relatively stable climate since the last ice age ended about 12,000 years ago, conditions have varied—sometimes for more than a century at a time—from much cooler and wetter to very warm and dry.

So there is nothing new about climate change. What does appear to be different is the possibility of a new cause of climate change. Now, human influence on natural processes and cycles may affect the range of temperatures near the Earth's surface, amounts and patterns of precipitation, and other important aspects of weather, like the frequency and severity of storms.

The atmosphere contains small concentrations of carbon dioxide and other gases that absorb a portion of the sun's energy as it is radiated back towards space from the Earth. This greenhouse effect warms the lower atmosphere and planet surface. Scientists have shown that concentrations of so-called greenhouse gases have increased dramatically since the beginning of the Industrial Age about 200 years ago, as a direct result of human activities—and that the concentrations are still rising.

Though scientists are not as certain about the effects of this change on climate, some think climate change could be disastrous and has already begun. A recent assessment by the United Nations-based Intergovernmental Panel on Climate Change concluded that "the balance of evidence...suggests a discernible human influence on global climate." The panel's assessment projects a rise in global mean temperature of about 2°C by the year 2100.

Other scientists do not yet find a human effect on climate and do not expect one. Obviously, much remains to be learned.

And while answers to questions about changing carbon dioxide levels, temperature, and precipitation patterns are important to virtually all sectors of the U.S. economy, they are especially important to agriculture.

In the United States, fine-tuning agriculture to match environmental conditions and to tolerate highly variable weather has allowed us to provide the best quality and greatest diversity of food ever known—and at reasonable prices. This bounty could be threatened if rising temperatures and altered rainfall patterns catch us unprepared.

For that reason, the Agricultural Research Service (ARS) has taken an active role in providing research results that are helping scientists predict how crop and animal production systems and agroecosystems will respond to change.

This issue of *Agricultural Research* presents a wide sampling of ARS studies and results that are directly applicable to the subject of climate change. Included is basic science about how plants respond at the biochemical level to temperature and drought stresses. We're developing crop varieties that better withstand heat and drought, and we're improving predictions of possible climate change effects on water supplies.

Our investigations of agriculture's contributions to greenhouse gas emissions show how management and conservation practices reduce those emissions and how agriculture can help reduce total global emissions.

Such information is necessary for making informed decisions and formulating appropriate policies. The feature article on page 4, "Preparing Agriculture for a Changing World," is especially timely, because environmental ministers from over 160 nations are meeting periodically to negotiate an international agreement to decrease emissions of greenhouse gases.

Of course, ARS researchers do not work alone in addressing global issues. We are but one agency in the United States Global Change Research Program—established by the Global Change Research Act of 1990—and are part of an even larger international community of scientists. Information about the U.S. program is available on the World Wide Web at http://www.usgcrp.gov/usgcrp/GCRPINFO.html

In addition, the ARS National Agricultural Library provides research and educational institutions access to one of the world's most extensive collections of data on both agricultural and natural ecosystems. Their challenge is to help us integrate and apply that knowledge to understanding global change, since much of the information was collected to support other agricultural research programs and objectives.

Climate change is only one aspect of environmental change that may affect the entire world. Global environmental change, commonly called global change, refers to large-scale changes—whether of natural or human origin—in Earth's biological, geological, hydrological, and atmospheric systems.

Other examples of global change include the direct effects of rising carbon dioxide levels on plants and ecosystem processes, depletion of the stratospheric ozone layer that filters out harmful radiation, declining biological diversity, and processes like deforestation and desertification that threaten the natural resources that sustain us.

These, too, are issues that require our attention now, because they may limit our options in the future. And to the extent that agriculture contributes to, is affected by, or can mitigate these changes, ARS scientists will continue to search for knowledge and solutions.

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for Global Change