Climate change and oilseed production

Few issues are as contentious or complex as climate change. *inform* recently interviewed a number of industry experts to help assess the sorts of changes likely to confront oilseed production in the next 50 years as a result of climate change.

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The year is 2058. World population has passed 9 billion. The amount of food produced between 2008 and 2058 has exceeded the amount produced in the previous 10,000 years. The global mean temperature has increased by 1 to 3°C. Levels of atmospheric CO_2 have reached 550 parts per million (ppm), up from the current level of around 385 ppm. Sea levels have risen 30 centimeters.

Given climate and atmospheric changes of this sort—which are within the parameters suggested as likely by leading climate change researchers—how are agribusiness in general and oilseed production in particular likely to fare?

VARIABILITY IS GREATEST CHALLENGE

The experts *inform* consulted were unanimous in predicting that unpredictability will be the hallmark of climate change.

Most oilseed crops are rainfed crops, making the expected high degree of variability of rainfall a challenge in every region of the world (see Table 1). Although temperature rise will cause a shift in planting dates, which will benefit some areas, variability in rainfall is seen as a potentially greater management challenge for farmers.

"We expect we will be entering into a period where rainfall patterns will be even more variable than they have been, with a greater intensity of precipitation—or lack of it," said Jerry Hatfield, lead author of the section on agriculture in a report released in June entitled "The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity."

The report was published by the U.S. Climate Change Science Program; Hatfield is laboratory director of the National Soil Tilth Laboratory in Ames, Iowa, USA, which is a unit of the Agricultural Research Service of the U.S. Department of Agriculture.

The report, which generalizes to other areas of the world, found that:

- Oilseed and grain crops will mature more rapidly, but increasing temperatures will boost the risk of crop failures,

TABLE 1.
Examples of possible impacts of extreme weather and climate events due to climate change[a]

Phenomenon and direction of trend	Likelihood	Agriculture, forestry, and ecosystems	Water resources
Over most land areas, warmer and fewer cold days and nights, and more frequent hot days and nights.	Virtually certain.	Increased yields in currently colder climates; decreased yields in warmer environments; increased insect outbreaks.	Effects on water resources relying on snowmelt; effects on some water supplies.
Warm spells/heat waves. Frequency increases over most land areas.	Very likely.	Reduced yields in warmer regions due to heat stress; increased danger of wildfire.	Increased water demand; water quality problems, e.g., algal blooms.
Heavy precipitation events. Frequency increases over most areas.	Very likely.	Damage to crops; soil erosion; inability to cultivate land due to waterlogging of soil.	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved.
Areas affected by drought increase.	Likely.	Land degradation; lower yields/crop damage and failure; increased livestock stock death; increased risk of wildfire.	More widespread water stress.
Intense tropical cyclone activity increases.	Likely.	Damage to crops; uprooting of trees; damage to coral reefs.	Power outages causing disruption to public water supply.
Increased incidence of extreme high sea levels (excludes tsunamis).	Likely.	Salinization of irrigation water, estuaries, and freshwater systems.	Decreased freshwater availability due to saltwater intrusion (a result of rising sea levels).

[a]*These impacts are based on projections to the mid- to late-21st century.*
Source: Intergovernmental Panel on Climate Change Fourth Assessment Report, Climate Change 2007 Synthesis Report, Summary for Policymakers, *2007*

particularly if precipitation decreases or becomes more variable.

■ Weeds will grow more rapidly under elevated atmospheric CO_2 and will expand northward in the Northern hemisphere and southward in the Southern hemisphere. The authors also noted that recent research suggests that glyphosate—the most widely used herbicide in much of the world—loses its efficacy on weeds grown at increased CO_2 levels.

■ Disease pressures on crops and animals likely will increase with earlier springs and warmer winters, which will allow higher survival rates of pathogens and parasites.

Regional variation in warming and changes in rainfall also will affect spatial and temporal distribution of disease.

■ Climate change will affect the distribution and life cycles of crop pests, with some pest species able to complete more generations in a year.

■ The growing season already has increased by 10 to 14 days over the last 19 years across the temperate latitudes of the United States. The distribution of species has also shifted.

■ Although biotech seed companies will continue to develop varieties with increased resistance to stress from lack of water and insect infestation, such modifications "have not altered the basic temperature response or CO_2 response of the biological system," the authors said.

Another variable is the intrusion of brackish water into freshwater aquifers in areas where irrigation is primarily from groundwater, which already is happening in the central United States, China, and India (in areas away from the coasts). New crop varieties that can tolerate high salinity

levels will need to be developed; yield and oil content are likely to be affected.

Volatile weather patterns are liable to produce equally volatile swings in crop pricing and supply, noted Eric Jackson, CEO of CP Holdings, L.L.C., a carbon consultancy based in Stillwater, Minnesota, USA. Swings in production will affect transportation and basis pricing as well, he said, adding that "the whole thing will become a tossed salad every year. Unpredictability has become the hub from which all spokes radiate."

The lack of predictability will affect business as usual, all the experts agreed, and oilseed processing facilities most likely will need to be relocated as crop production centers shift geographically.

OTHER REGIONS

Soy exports from Brazil could fall by as much as 25% over the next 12 years as a result of climate change, according to an analysis released in August 2008 by the state-run EMBRAPA agricultural research institution. Prolonged droughts, increased flooding, powerful hailstorms, and rising temperatures will affect soy production more than any other commodity crop, the report suggested.

This analysis, entitled "Global Warming and Future Scenarios for Brazilian Agriculture," estimated that soy production in Brazil will drop by some 40% over the next 50 years. Northeastern Brazil will be most affected, the authors said.

In general, temperature increases in the more temperate areas of North and South America are likely to have a beneficial effect on crop yields in the short term (the next several decades), suggests David Fischhoff, vice president for technology strategy and development for Monsanto Co. in St. Louis, Missouri, USA.

"In tropical zones—particularly in southern Asia and Australia—we are likely to see a greater severity of extreme weather patterns such as monsoons, rainfalls, and drought," he noted.

In southern, central, and eastern Europe, the frequency and intensity of heat waves are projected to increase, according to the National Geographic Society (Washington, DC, USA). Effects in Asia are expected to be variable: Yields could increase by up to 20% in east and southeast Asia, while decreasing up to 30% in central and south Asia. The incidence of marginal land with alkaline soil is expected to rise, especially in China and India. Therefore, nonedible oil crops such as jatropha that can grow on marginal land will play an increasingly important role in those areas.

Africa is projected to be hard hit by climate change. A decline of up to 50% is expected in the area of arable land suitable for crops, the length of growing seasons, and the amount of food produced in much of Africa.

SOME POSITIVES

Monsanto has taken a considered look over the past several years at the implications of climate change. "We tend to be of the opinion that the rate of change is probably at the higher end rather than the lower end [of published predictions]," Fischhoff said.

However, there are some positives worth noting, he emphasized. For one, plant breeding is always done under local conditions that are constantly changing. "We know today that the maturity zones for corn and soy have altered over the past couple of decades as temperatures

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■ The Global Reporting Initiative (GRI), which counts Bunge Ltd. and the Rabobank Group among its network of collaborators, has developed one of the most widely used sustainability reporting frameworks. This framework sets out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. GRI is a collaborating center of the United Nations Environment Programme; see www.globalreporting.org for more information.

WEBSITES OF INTEREST:

■ The Nobel Prize-winning group known as the Intergovernmental Panel on Climate Change has released four reports that are available at www.ipcc.ch.

■ The U.S. Climate Change Science Program report mentioned in this article is available at www.climatescience.gov/Library/sap/sap4-3;default.php.

■ The Global Change Master Directory at http://gcmd.gsfc.nasa.gov provides a wealth of climate-related data.

■ Finally, issues as diverse as sustainable supply-chain practices and energy efficiency in buildings are covered at the virtual home of the World Business Council for Sustainable Development at www.wbcsd.org.

have warmed. Plant breeders continue to increase yields even in the face of that. Therefore, plant breeding for annual crops is likely to be able to adapt plants pretty effectively. For tree crops like palm and coconut, the growth cycle is much longer, which will affect adaptation strategies for those oilseeds."

Dealing with the challenges of climate change will take the involvement of the entire agricultural industry, Fischhoff suggested, which is already happening to some degree. Traditional breeders and biotech companies need to work together, he said, as do agricultural chemical and equipment manufacturers.

Fischhoff's observation is echoed by Karol Aure-Flynn, who is executive director of Food & Agribusiness Research and Advisory for Rabobank International in New York.

"The long-term success of agribusiness is always determined by the ability of all concerned to manage risks and opportunities associated with the climate," she said, adding that "successful management of the challenges we face from climate change will come through a combination of investment in and development of new research and technologies as part of a sector-wide commitment to adjusting for the future."

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