BOX 8.4 **Agriculture and Climate Change**

After the energy sector, agriculture, deforestation, and other land use changes have been the second largest contributors to greenhouse gas emissions,[74] accounting for about 25% of global emissions. The changing climate will, in turn, affect agricultural production. Some agricultural areas, such as Bangladeshi rice fields, will flood more often, and other areas will be hotter and drier. New pest and disease outbreaks will occur.[75,76] According to the US Department of Agriculture, exposure to temperatures that are 1° to 4°C above optimal reduces vegetable yield, and temperatures more than 5° to 7°C above optimal can cause severe or total production loss. These data highlight the fact that agricultural activities are intimately connected to climate change. We cannot address one without addressing the other.

These are issues that the agricultural community is very concerned about. Farmers are already faced with dramatic changes to their operations. For example, in California, the acres devoted to cotton farming, a water-intensive venture, have decreased every year. Some agricultural economists predict that farmers will need to adopt alternative agricultural practices and economic activities and that some farmers will need to migrate away from locations where farming and livelihood become unfeasible.

The research community is seeking ways to use water more efficiently and to develop crop varieties that are resilient to stress. For example, the flood-tolerant rice varieties released by breeders at the International Rice Research Institute (see Chapter 1) are already helping farmers deal with the increased number of floods observed over the past few years. Through the Water Efficient Maize for Africa (WEMA) project, drought-tolerant corn could be available to farmers within the next 2 or 3 years.

Farmers planting herbicide-tolerant soybean, corn, cotton, and canola have been able to convert much of their operations to "no-till" production. In some regions of the world, this practice keeps more organic matter on the land between plantings and leaves the soil relatively undisturbed, reducing erosion.[33,77] Because tillage is reduced, greenhouse gas emissions resulting from burning of tractor fuel[78] or production of feed required for draught animals in smallholder systems are also reduced.[79,80] Reduced tillage also minimizes moisture loss, an increasingly important goal in the face of climate change. Because soils contain more carbon than all terrestrial vegetation and the atmosphere combined, no-till practices may mitigate climate change through carbon sequestration.[79,81,82]

According to the legal analysts Martha Marrapese and Keith A. Matthews and agricultural economists Richard Sexton and David Zilberman, higher-yielding and pest-resistant crops developed through genetic engineering have reduced the use of carbon-intensive inputs including fuels and other chemicals such as insecticides.[74]

Adoption of these genetically engineered crops can reduce fuel consumption by 19% on average.[83] Sexton and Zilberman reported that carbon emissions associated with production, packaging, and transport of agrochemicals could be reduced in the United States through the use of genetically engineered cotton in an amount equivalent to removing 23,000 cars from the road.

Marrapese and Matthews estimated that by the mid-21st century, the temperatures in California, one of the largest and most productive agricultural regions in the world that produces 50% of the nation's fruit, vegetables, and nuts, may exceed those optimal for the growth of these trees.[74]