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EDITORIAL

Agriculture and Climate Change

How will increases in levels of CO_2 and changes in temperature affect food production? A recently issued report analyzes prospects for U.S. agriculture 1990 to 2030.* The report, prepared by a distinguished Task Force, first projects the evolution of agriculture assuming increased levels of CO_2 but no climate change. Then it deals with effects of climate change, followed by a discussion of how greenhouse emissions might be diminished by agriculture. Economic and policy matters are also covered.

Most forecasts of the future miss reality by a large margin because of the unforeseen. However, trends of increases in agricultural productivity have been robust. If climate does not change drastically, U.S. agriculture is likely to continue to expand production per hectare by about 1.5% per year. The report points out that from 1930 to 1987, while population nearly doubled, the land area required for crops in the United States shrank by one-seventh. Were climate to remain steady, the crop land area needed to meet domestic demand and projected increased exports would decrease from 134 million hectares in 1987 to about 88 million hectares in 2030. Those estimates did not factor in beneficial effects of increased CO_2 in enhancing yields and lessening need for water by plants. The increased efficiency in production would be based largely on genetic improvements. Traditional plant breeding continues to produce better varieties. In addition, the potentials of biotechnology are only beginning to be exploited.

How the climate would respond to more greenhouse gases is uncertain. If temperatures were higher, there would be more evaporation and more precipitation. Where would the rain fall? That is a good question. Weather in a particular locality is not determined by global averages. The Dust Bowl of the 1930s could be repeated at its former site or located in another region such as the present Corn Belt. But depending on the realities at a given place, farmers have demonstrated great flexibility in choosing what they may grow. Their flexibility has been increased by the numerous varieties of seeds of major crops that are now available, each having different characteristics such as drought resistance and temperature tolerance. For example, in future, varieties of winter wheat are likely to have an even larger role than now. Seeds are planted in the autumn, and the crop is harvested ahead of the drought and heat of midsummer. The area suitable for this crop has already been doubled as a result of success of plant breeders.

In past, agriculture has contributed about 5% of U.S. greenhouse gases (CO_2, CH_4, and N_2O). Two large components have involved emissions of CO_2 from farm machinery and from oxidation of organic matter in soil due to tillage. Use of diesel fuel and more efficient machinery has reduced emissions from that source by 40%. In some areas changed tillage practices (no till) are now responsible for returning carbon to the soil.

The report identifies an important potential for diminishing net U.S. emissions of CO_2 by growth and utilization of biomass. Large areas are already available that could be devoted to energy crops. Estimates of potential impact included one from the Office of Technology Assessment. It hypothesized that 30 million hectares might be employed, ultimately resulting in production of 6 to 8% of current U.S. energy consumption. Another estimate suggested that the United States could offset half of its current emissions of CO_2 related to fossil fuels by planting 140 million hectares with trees. Other projections (not cited) indicate a potential that all U.S. liquid fuels eventually could be obtained from biomass. To achieve such a goal would require selection and development of fast-growing, high-yielding trees or herbaceous plants, plus improved methods of processing their cellulose to ethyl alcohol. A substantial potential for diesel fuel lies in the seeds of some plants such as sunflower and rape. In addition to providing local benefits technology developed in the United Staters would likely find applications in other countries, resulting in diminished global emissions of CO_2.

To achieve long-term goals of using biomass energy and maintaining reliable food production under changing conditions will require a vital agricultural research and production system. But the goals can be reached. As the report states, "Unlike the earth's endowment of land and water, which are fixed and growing relatively smaller compared to demands on them, the capacity for acquiring knowledge has no known limit."

Philip H. Abelson

**Preparing U.S. Agriculture for Global Climate Change* (Council for Agricultural Science and Technology, Ames, IA, 1992).