Regional and Global Assessments

In studying the impacts of climate change, attempts are made to link state-of-the-art models developed by researchers in disparate disciplines--including climatology, agronomy, and economics--in order to project future food supplies. Present global circulation models, or GCMs, calculate the temporal and spatial transports and exchanges of heat and moisture throughout the Earth's surface and atmosphere. These models are used to predict changes in temperature, precipitation, radiation, and other climate variables caused by increases in greenhouse gases in the atmosphere. They are used as well to develop "practice climates" or climate change scenarios for use in impact studies. Crop models then predict the response of specific crops to alternative sets of climate and CO_2 conditions. Results in terms of changed crop yields and water use are then subjected to an economic analysis based on a linked model system of international food trade. Such comprehensive, interdisciplinary research is needed to improve our understanding of the interactive biophysical and socioeconomic effects that may result from global environmental change. At the same time, however, the superposition of model upon model, each with its own range of inaccuracy, amplifies the overall range of uncertainty in the final result.

The GCM-based assessment of the IPCC contemplates a change in global surface temperature of 1.5 to 4.5°C by the year 2050, as a result of enhanced greenhouse gases. While global agricultural production may increase at the lower limit of the predicted range or decrease at the higher limit, global effects measured with current economic valuation techniques are generally predicted to be moderate. The reason is that the world economic system has been generally effective in fostering adaptation to current biophysical constraints on crop production and in realizing opportunities for improving crop production. This macroeconomic perspective, however, speaks only to the averaged global effect and not to specific regional and social impacts. Model studies done to date concur that there will be significant changes in regional agricultural patterns as a result of climate change. All regions are likely to be affected, but some regions will be impacted more adversely than others. The timing of regional effects--who gains or loses when and for how long--will also be complex, as is illustrated in Figure 2 in terms of modeled changes in country-by-country wheat yield.

Winners and losers

Modeled studies of the sensitivity of world agriculture to potential climate change have suggested that the overall effect of moderate climate change on **world food** production may be small, as reduced production in some areas is balanced by gains in others. The same studies find, however, that vulnerability to climate change is systematically greater in developing countries--which in most cases are located in lower, warmer latitudes. In those regions, cereal grain yields are projected to decline under climate change scenarios, across the full range of expected warming. Agricultural exporters in middle and high latitudes (such as the U.S., Canada, and

Australia) stand to gain, as their national production is predicted to expand, and particularly if grain supplies are restricted and prices rise. Thus, countries with the lowest income may be the hardest hit.

Yet, not all impacts in developing countries may be negative. Inland areas located far from sources of precipitation may suffer increased aridity, whereas areas in the path of rain-bearing winds may benefit from increased rainfall. A point that needs to be stressed is that the ability of any country to take advantage of the opportunities and to avoid the drawbacks as climate changes will depend on the availability of adequate resources as well as on the quality of the research base. The presently inadequate capacity of agricultural research systems in the tropics and semi-tropics will need to be rectified, and this task can best be achieved through international cooperation.