Water will drive California response to climate change

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California's agricultural industry has a comparative advantage in its climate and water supplies. However, global climate change may slowly change both of these foundations (see pages 84 to 96). Clearly, it is useful to understand the fundamental driving forces of climate change and the range of uncertainty around them. Several UC research groups are conducting such analyses; while it is still too early to predict outcomes, it is not too early to conjecture on major effects on California agriculture.

In researching the impacts of global climate change, one is immediately struck by two unusual characteristics. First, knowledge of global climate change is very uncertain. While there is a strong scientific consensus that the global climate is changing, there is much less consensus on its impacts on relatively small areas such as California. For example, there is a wide range of model predictions for future sea level rise and a range of opinion concerning historical climate variability. One approach to such uncertainty would be to not do anything costly until the scientific proof is overwhelming. But there may be a high cost associated with inaction. An alternative approach is to emphasize measures that reduce the apparent driving forces behind global climate change. The implicit assumption is that the expected present value cost of inaction in the future is significantly greater than the current costs of controlling precursors. Clearly, the social costs of alternative decisions under uncertain climate change are as important as the fundamental science of the process.

The second characteristic that makes impacts so hard to measure is the time scale. Climate change will probably occur more slowly than the 50- to 100-year period during which California's natural resources were developed for agriculture. We probably have time to adjust, but may have significant changes to adjust to. In this sense, California agriculture's adaptation may not be greatly different from its adaptations to other long-term trends, such as changing demands and varieties, or improved quality control and marketing, which are necessary in growing regions worldwide. Some of the more significant expected changes are:

Water supply. California's economy runs on a complex network of surface water and groundwater storage and extensive conveyance systems to move water from its natural sources to arid areas where agricultural, urban and residential demands are greatest. Climate change would probably alter the pattern, variability, amount and temperature of precipitation in California. These changes would significantly reduce the ability of the existing surface-water storage infrastructure. In addition, snowpack, which enhances the operating efficiency of dams, would be greatly reduced.

Flood control. The severity and frequency of flood events would be dramatically altered in California. Most storage dams provide water supply and flood protection. Unfortunately, increased flood protection implies reductions in the effective water supply from dams alone. Increases in flood protection capacity require a trade-off against the need for increased surface supply capacity to partially offset reduced snowpack. Conjunctive use of surface and groundwater — moving over-year storage underground — may reduce this problem.

Hydropower. Currently, hydropower plays an important role in generating energy for peak use during the summer. The shift to reduced surface storage, smaller summer snowpack runoff and earlier rainfall would reduce the total quantity of hydropower, but equally significantly, would reduce its flexibility to match varying power demands. The cost of agricultural pumping, particularly during peak periods, is likely to increase.

Crop yields. Crop yields would be altered by temperature and carbon dioxide effects. A middle-range projection is a 4°F rise in average temperature over the next 50 years. A statistical regression on the county yields of California crops shows that the combined effect of temperature, precipitation and carbon dioxide could cause a 12% increase in cotton yields by 2060. However, this increased yield is based on a 9% increase in evapotranspiration, further stressing water supplies. From a statewide perspective, a rise in growing-season temperature would tend to shift growing regions north, and is unlikely to have much statewide impact.

Sea level rise. The forecasted increases in sea levels would mostly affect California agriculture through changes in the Sacramento Delta. Rising sea levels would shift the dynamic and seasonal interface between saltwater and freshwater flows farther into the Delta and increase flood risks. There would be direct effects to Delta growers, and indirect impacts on supplies for southern agricultural regions.

This litany of problems must be viewed in the context of the dramatic changes and challenges that California agriculture has met over the past century. If the effects of global warming proceed as expected by most scientists, California agriculture would have to use the same skills to adjust to increased water scarcity as were used to develop the current bountiful water supplies and adjust to changing markets. Informed discussion is needed on the national costs of actions to control global warming and the costs of response and adjustment by natural resource–based industries. Water supplies will continue to be problematic and require changes, with or without climate change. But California, with its extensive infrastructure and mature organization, should be in a better position to adapt than most agricultural regions of the world.