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Crop yields largely unharmed in geoengineered climate

Concerns about the negative impacts of 'sunshade' geoengineering on global food security are not supported by a recent modelling study, the first to simulate yield changes in a geoengineered climate. However, to mitigate climate change, the researchers suggest actions to reduce CO_2 emissions are safer than introducing geoengineering projects, partly because some regions may actually suffer reduced crop yield in a geoengineered climate.

Unless emissions of CO_2 from human activities are reduced, climate change will affect crop yields, particularly through changes in rainfall and temperature. The impact will vary across regions and there is the risk that food supply, particularly in already vulnerable areas, could be threatened.

One short-term measure proposed in the fight against climate change is to reflect back some of the sun's radiation before it reaches the Earth, thereby counteracting global warming. An example of such an approach, called solar radiation management (SRM), is to deflect sunlight off sulphate particles that have been injected into the stratosphere (upper atmosphere). However, there are concerns that such 'sunshade' geoengineering schemes could reduce crop yields and lower the global production of food by causing changes in precipitation.

This study compared large-scale changes in crop yields under two future climate scenarios. Changes in global temperatures and precipitation relative to today were modelled first for: a) a doubling of the atmospheric concentration of CO_2 compared with current levels ('2 x CO_2 scenario') and b) a doubling of the atmospheric concentration of CO_2, but with a climate modified by SRM to maintain average global temperatures at current levels ('SRM scenario'). These two climate change scenarios were then used to estimate changes in the yields and production of three major crops: wheat, maize and rice.

In addition to the effects of temperature and precipitation on crop yields, the impact of elevated levels of CO_2 on crop productivity was included in the analysis, as previous studies have found that higher levels of atmospheric CO_2 act like a fertiliser and can increase yields.

For the 2 x CO_2 scenario, overall small changes in global yields of the three crops were found. There was a slight fall in yield for maize and a slight increase for wheat and rice. These were caused by the combined negative effects of climate change and the positive impact of increased fertilisation by CO_2. Higher temperatures, rather than changes in precipitation, were responsible for most of the reduction in crop yields.

Under the SRM scenario, the yields of all three crops increased at all latitudes, mainly through the beneficial influence of higher CO_2 levels, compared with current conditions, but lower temperatures compared with the 2 x CO_2 scenario. Nevertheless, changes in yields and production are not uniform across all regions and it is likely that the current pattern of food production and global food markets will be altered. Although on a large regional scale SRM is simulated to increase yields compared to the 2xCO_2 scenario, individual small regions may exhibit losses in yields due to local climate change. In particular when these regions are areas of subsistence farming, this may cause local food insecurity.

In addition, the researchers point out that SRM does not modify other harmful effects of higher CO_2 levels, such as ocean acidification, which could also affect marine food supplies. Given the anticipated and unknown consequences of modifying the climate by SRM, the researchers point out that the reduction of CO_2 emissions is the most certain way to reduce risks of dangerous climate change impacts.

Source: Pongratz, J., Lobell, D. B., Cao L. and Caldeira, K. (2012). Crop yields in a geoengineered climate. *Nature Climate Change*. DOI: 10.1038/NCLIMATE1373.
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