America's Farming Future: The Impact of Climate Change on Crop Yields

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Crop yields are strongly dependent on average summertime temperatures and extreme heat waves, both of which are projected to increase in the coming century. A statistical model was created to predict U.S. yields to 2100 for three crops: maize, soybeans, and rice, for both a low and high-emissions future scenario (RCP 4.5 and 8.5). The model is based on linear regressions between historical crop yields and daily weather observations since 1970 for every county in the U.S. Geographically, counties further south are more sensitive to heat extremes, implying that crops will grow better farther north in the future. The model shows that climate change will have a strong influence on maize and soy yields, and less on rice. For the high emissions scenario, crop yields are predicted to decrease by 3.8% per decade for maize, 2.4% for soy, and 0.83% for rice, if there are no compensating improvements in agricultural technology. Decreases in crop yields for the low emissions scenario are about half as much. This compares with an average increase in yields of 24%, 18%, and 17% per decade since 1970 due to improvements in plant breeds and farming practices. Climate change results in a loss of $23 billion for maize and $11.5 billion for soy per year in 2100 for the high emissions scenario, in today’s prices. This study highlights the importance of accounting for future costs of climate change when choosing today’s energy policies, and motivates continued improvements in agricultural technology to compensate for warming temperatures.

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