Impacts of Climate Change on Agriculture

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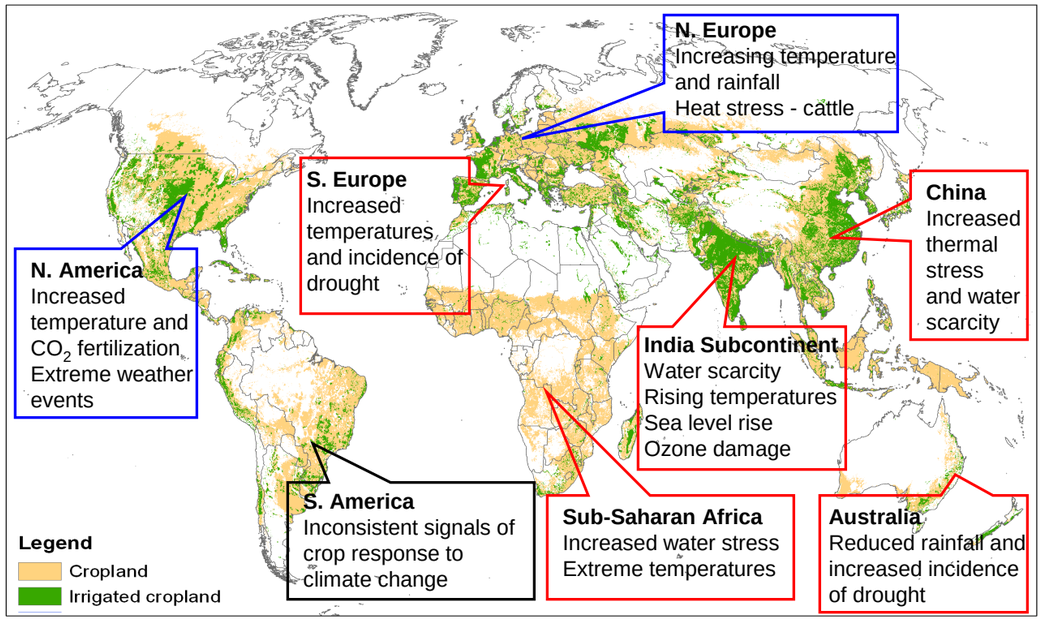
Climate change directly impacts on crop productivity and food production. Over the next 50 years, regional asymmetries in climate change patterns may deepen existing production and consumption gaps between the developed and developing world. Critically, current assessments are mainly limited to alterations in mean climate, but other effects such as changes in extreme weather events or the effects of glacial retreat on water resources are also likely to be important. Uncertainties in regional precipitation patterns, agricultural sensitivity to climate and crop response to rising atmospheric CO_2 affect our ability to project climate change impacts on agriculture at both regional and global scales.

Temperature – In mid to high latitudes moderate warming may benefit cereal crop and pasture yields, but in seasonally dry and tropical regions even slight warming decreases yields.

Precipitation – Rainfall plays a critical role in year to year variability of crop yield. Broadly speaking, precipitation is expected to increase in high latitudes and decrease at mid to low latitudes although there is high regional and seasonal variation in the level of certainty in these projections

Extremes – Changes in the frequency and intensity of extreme weather events will have significant consequences for agriculture. Increases in extreme temperature events can have high impacts on crop yields and heat stress in cattle. Increasing occurrence of drought is projected for many important agriculture regions. Extreme rainfall and flooding may also have severe consequences for agriculture at the local scale and can effect grain quality as well as quantity.

Water Resources – Large areas of agriculture exists in catchments dominated by snow and glacier melt. Climate change will shift the seasonality of water availability in these areas causing earlier and more intense runoff. The increase in water at this time of year may confer no benefits to agriculture however, if there is insufficient storage capacity.



Estimated regional changes by 2050 are indicated by the colour of the text box with **Red** indicating increase and **Blue** a decrease in agricultural productivity. N.B. Regional differences exist at a finer scale than are shown on this map for example countries in Sub-Saharan Africa such as Ethiopia are projected to have increased yields.

Key Uncertainties

CO_2 fertilization: Crop physiological response to atmospheric CO_2 concentrations and impacts on yields

Crop Sensitivity: Sensitivity of different crops to local scale changes in climate.

Climate model uncertainties: climate sensitivity, carbon cycle feedbacks, model parameterization and structure, emissions scenarios.

Regional precipitation patterns: There is less agreement in climate models in projections of regional precipitation patterns than temperature.

Tropical storms and Sea Level Rise – Climate change is projected to decrease frequency but increase intensity of tropical storms, although this is highly uncertain. Sea level is set to rise as a consequence of increasing global temperatures. Both will increase the vulnerability of coastal and low lying agricultural areas to factors such as coastal inundation, soil salinization and intense rainfall..

CO_2 Fertilization – Evidence suggests that total crop and pasture yield may rise when averaged across the globe due to effects of CO_2 fertilization, which is expected to offset negative impacts of a changing climate. The accuracy of these projections and thus future food security depend critically on the magnitude of the CO_2 fertilization effect under actual growing conditions. Elevated CO_2 is thought to decrease grain quality.

Indirect Climate Impacts:

Ozone – Physiological damage to crops by increased ground-level concentrations of ozone (O_3) reduces yield. O_3 concentrations are projected to rise significantly due to anthropogenic pollution especially in Asia.

Pests & Pathogens – Rising temperatures may alter the frequency and intensity of pest and pathogen outbreak. However, crop/ pest interactions are complex and poorly understood in the context of climate change.

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