Direct and indirect impacts of climate change on wheat yield in the Indo-Gangetic plain in India

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The Sustainable Development Goals (SDGs) were adopted by all United Nations members states in 2015. “Erase hunger” and “Establish good health and well-being” are part of these goals and have major implications for agriculture and raises the question of how agriculture will be impacted by climate change. This work focuses on the potential impacts of the changing climate for agriculture, using the example of wheat yield in the Indo-Gangetic Plain (IGP) in India. First, the potential future changes in temperature and precipitation are examined over the IGP in regional climate simulations. The results show an increase in mean temperature and precipitation as well as maximum temperature during the growing season or Rabi season (November-April). Then, the direct (via temperature and precipitation) and indirect (via limiting irrigation) impacts of climate change on wheat yield are derived with a crop model for four selected sites in different states of the IGP (Punjab, Haryana, Uttar Pradesh and Bihar). The chosen sites are spread across the region to represent its major wheat growing areas.

The direct impact of climate change leads to wheat yield losses between -1% and -8% depending on the site examined and the irrigation regime chosen (6, 5, 3 or 1 irrigations). In this experiment, the number of irrigations remain the same in present and future climate. Then, when including the indirect impact of climate change the losses become much higher, reaching -4% to -36% depending on the site examined and by how much the irrigation is limited. This work shows the sensitivity of wheat yield to direct and indirect impacts of climate change in the IGP. It also emphasizes the complexity of climatic risk and the necessity of integrating more indirect impacts of climate change to fully assess how it affects agriculture.