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Future global crop production increases by adapting crop phenology to local climate change

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Broad evidence is pointing at possible adverse impacts of climate change on crop yields. Due to scarce information about farming management practices, most global-scale studies, however, do not consider adaptation strategies.

Here we integrate models of farmers' decision making with crop biophysical modeling at the global scale to investigate how accounting for adaptation of crop phenology affects projections of future crop productivity under climate change. Farmers in each simulation unit are assumed to adapt crop growing periods by continuously selecting sowing dates and cultivars that match climatic conditions best. We compare counterfactual management scenarios, assuming crop calendars and cultivars to be either the same as in the reference climate – as often assumed in previous climate impact assessments – or adapted to future climate.

Based on crop model simulations, we find that the implementation of adapted growing periods can substantially increase (+15%) total crop production in 2080-2099 (RCP6.0). In general, summer crops are responsive to both sowing and harvest date adjustments, which result in overall longer growing periods and improved yields, compared to production systems without adaptation of growing periods. Winter wheat presents challenges in adapting to a warming climate and requires region-specific adjustments to pre and post winter conditions. We present a systematic evaluation of how local and climate-scenario specific adaptation strategies can enhance global crop productivity on current cropland. Our findings highlight the importance of further research on the readiness of required crop varieties.