Adaptation pathways to maintain global wheat production through the 21st century

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Abstract

Agricultural adaptation has the potential to reduce the negative impacts of climate change on crop yields. However, researchers have not yet identified when and what adaptation options are required to meet this challenge globally. Describing the pathways of necessary adaptation (i.e., temporal sequences of necessary adaptation) is useful because these show us the timing and intensity of the adaptations required. Here we present nation-wise adaptation pathways for global wheat production through the 21st century based on sequential introduction of the minimum adaptation measures necessary to maintain current yields. We considered two adaptation options with multiple intensity levels each: (i) expanding irrigation infrastructure; and (ii) switching crop varieties and developing new crop varieties. We show that the adaptation pathways are quite different among the current major wheat-producing countries. Although wheat yields could be maintained at the current level by the adaptation assumed in this study in most countries, the pathways show that a large expansion of irrigation and the development of new heat-tolerant varieties will be required in several countries. In addition, we found that the attainable wheat yield by adaptation is notably dependent on whether forecasts of necessary adaptation are available or not, in case it takes substantial time to implement an adaptation after planning it and the feasible rate of adaptation is limited. Therefore, forecasting the adaptation required in the future will be important to achieve the benefit of adaptation pathways.