

Balancing crop production and groundwater table recovery by cropping system adaptation in the North China Plain

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Introduction. To achieve high crop productivity and guarantee food security in China, major cropping regions, such as North China Plain (NCP), demand large inputs of water for irrigation. But this has led to severe environmental problems such as groundwater over-extraction. Therefore, balancing the trade-offs between relieving the water stress through less irrigation and maintain high grain yield is critical to the agricultural policy in China. We propose to replace the traditional wheat-maize cropping by a “water-saving” cropping system, and evaluate its potential benefit under climate change.

Methodology. In order to identify environmentally sustainable cropping systems. The DSSAT model is employed to quantify the yield impacts of replacing sequential double cropping by advanced relay intercropping in the south NCP, and to assess the water saving of replacing double cropping by single cropping with earlier sowing summer maize in the north NCP. We balance the yield loss in the driest regions of the NCP with the yield gain in the wettest parts across the study region, and shrink the area of double cropping to recover the underground water.

Results. Results in the observation sites of Linyi and Beijing show: 1) Adopting relay intercropping will lead to a 34% yield increase and 16% higher water productivity at Linyi site, with limited water increase of 15%. 2) Advanced single maize cropping will gain 30% more yield with only 26mm more irrigation water. The adaptation of spring maize suggested in previous studies would consume more water and result in lower water productivity due to the longer growth cycle and higher plant transpiration. 3) The new regional cropping system adaptation can reduce the winter wheat sowing area of 126,635 km², and save 69.83 mm water per year without reducing total NCP grain production.

Conclusions. Results show a potential benefit of suitable cropping system adaptation to guarantee crop production and advice water saving in agriculture in the North China Plain. The proposed regionally adopted cropping strategy and new crop management can further support a solid science-based agriculture adaptation policy making in this region, which can be further reformed in response to climate change.

References

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