

Reply to Vermeulen and Wollenberg: Distinguishing food security and crop yields

Vermeulen and Wollenberg (1) caution against interpreting our recent paper (2) as a call to concentrate food production in temperate areas. We did not intend our research to be interpreted as such. As Vermeulen and Wollenberg state, even very low yields can play an extremely important role in providing food security, particularly in low-income tropical countries. We agree that it is important to make the distinction between yields and food security.

As noted in our paper, the tradeoff between carbon and crop yields that results from expanding croplands is particularly strong in the tropics, where natural ecosystems generally store a lot more carbon and crop yields are lower. Even if yields in the tropics were doubled or tripled, the average tradeoff in the tropics would still be greater than in temperate areas. The regional difference in the carbon vs. food tradeoff highlights the

importance of increasing production on existing croplands, particularly in the tropics. Although not quantified in our analysis, yields can vary substantially within climate zones. Yield gaps tend to be greatest in low-income developing countries (3). Future research can expand on our approach (2) to determine the influence of management practices, such as irrigation and fertilizer, on current yield patterns, water availability, and excess nutrients in the environment.

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1. Vermeulen SJ, Wollenberg EK (2011) Benefits of tropical crops for food security. *Proc Natl Acad Sci USA* 108:E30.
2. West PC, et al. (2010) Trading carbon for food: Global comparison of carbon stocks vs. crop yields on agricultural land. *Proc Natl Acad Sci USA* 107:19645–19648.
3. Licker R, et al. (2010) Mind the gap: How do climate and agricultural management explain the 'yield gap' of croplands around the world? *Glob Ecol Biogeogr* 19: 769–782.

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