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Comparing the yields of organic and conventional agriculture

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Abstract

Numerous reports have emphasized the need for major changes in the global food system: agriculture must meet the twin challenge of feeding a growing population, with rising demand for meat and high-calorie diets, while simultaneously minimizing its global environmental impacts[1,2]. Organic farming—a system aimed at producing food with minimal harm to ecosystems, animals or humans—is often proposed as a solution[3,4]. However, critics argue that organic agriculture may have lower yields and would therefore need more land to produce the same amount of food as conventional farms, resulting in more widespread deforestation and biodiversity loss, and thus undermining the environmental benefits of organic practices[5]. Here we use a comprehensive meta-analysis to examine the relative yield performance of organic and conventional farming systems globally. Our analysis of available data shows that, overall, organic yields are typically lower than conventional yields. But these yield differences are highly contextual, depending on system and site characteristics, and range from 5% lower organic yields (rain-fed legumes and perennials on weak-acidic to weak-alkaline soils), 13% lower yields (when best organic practices are used), to 34% lower yields (when the conventional and organic systems are most comparable). Under certain conditions—that is, with good management practices, particular crop types and

growing conditions—organic systems can thus nearly match conventional yields, whereas under others it at present cannot. To establish organic agriculture as an important tool in sustainable food production, the factors limiting organic yields need to be more fully understood, alongside assessments of the many social, environmental and economic benefits of organic farming systems.

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Contributions

V.S. and N.R. designed the study. V.S. compiled the data and carried out data analysis. All authors discussed the results and contributed to writing the paper.

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Ethics declarations

Competing interests

The authors declare no competing financial interests.

Supplementary information

Supplementary Information

This file contains Supplementary Figures 1-10, Supplementary Tables 1-14, a Supplementary Discussion and Supplementary References. (PDF 759 kb)

Supplementary Data 1

This file contains data used in the meta-analysis. The data table shows the raw yield data, yield effect sizes and study information with categorical variables. (XLS 379 kb)

Supplementary Data 2

This file contains data that could not be used in the meta-analysis. The data table shows, in the spreadsheet 'exclusion6', study information and yield data of studies that were excluded because they did not meet selection criteria 6 (i.e. no information on an error term and sample size was available). In the spreadsheet 'exclusion1-5' information on studies that were excluded because they did not meet the basic selection criteria 1-5 (see methods) and the reason for exclusion is shown. (XLS 231 kb)

PowerPoint slides

PowerPoint slide for Fig. 1

PowerPoint slide for Fig. 2

PowerPoint slide for Fig. 3

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