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# Assessing current and future effects of agricultural management and soil degradation on global crop yields

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Continuing increases in global crop yield through technological advancement and fertilizer use have masked the fact that much current agricultural management practice is degrading the soil's inherent productive capacity. This is especially a problem where access to fertilizer is limited and low crop yields are directly contributing to malnourishment. Where fertilizers are used abundantly and yields are high, soil degradation is a largely hidden drag on productivity. How much crop and grass yield does humanity forego as a result of soil degradation and current agricultural management, now and in the future? And how much can improved agricultural management counter degradation and contribute to sustainable production? Integrated assessment models (IAM) coupled with global gridded crop production models (GGCM) are a suitable tool for scenario-based forecasting of crop yields and productivity. While many models focus on climate change impact on crop production, no model allows for a comprehensive assessment of agricultural management and soil degradation effects.

In this study we analyse possible methods and strategies for extending IAMs to include global coverage of important agricultural management and soil degradation processes and effects on crop yields. At one end of a spectrum, GGCM components can be modified to include additional soil and crop management variables, requiring strong process knowledge, and data for calibration and input. At the other end of the spectrum, field trial data linking agricultural management and soil degradation processes with crop yield can be aggregated by crop and soil type resulting in average annual yield reduction coefficients, which can be applied to GGCM yield predictions. In between are models of intermediate complexity with balanced reliance on data aggregation and process representation. For all methods a particular challenge is to develop spatial input data sets of currents agricultural management and state of soil degradation. From a strategic point of view, effort needs to be balanced between more process and management representation, and reduction of uncertainty through empirical anchoring. Finally, global remotely sensed NDVI, corrected for a range of effects, has been used as a measure of land degradation and could be used as independent calibration and validation data for the historic period of the forecast.