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"Management of land use systems for enhanced food security: conflicts, controversies and resolutions"

On the Use of Agricultural Systems Models for Exploring Technological Innovations under Climate Risk in Africa

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Abstract

One of the major challenges of the 21st century is to achieve food security under roughly a doubling in food demand by 2050 compared to present and marked shifts in climatic risks. Increased frequency and severity of extreme events are threatening future harvests, especially challenging agricultural production systems in African regions that are already food insecure. Sustainable intensification is required that meets the dual goal of improved environmental sustainability and economic efficiency. *Ex ante* evaluation of technological innovations to support agricultural production and food security taking into account climate-induced risks is of major concern. Here we consider technological innovations as new or improved agro-technologies, such as new breeds, integrated soil fertility practices or labour-saving technologies meeting the goals of sustainable intensification. Agricultural systems models, including process-based crop simulation, statistical crop yield models, economic optimisation and bio-economic models at household, regional and supra-national scales are in principle capable to quantify important environmental and economic performance indicators of alternative technologies and their variability under current and future conditions. In this paper, a systematic review is presented of such agricultural models with emphasis on their application to smallholder farming systems in Africa. Capabilities and limitations of these models and underlying data are summarised in view of the degree they meet predefined quality criteria and comply with the demands of evaluating relevant technological innovations in terms of their potential to maintain or increase crop yields and income at acceptable risk levels. This is illustrated by two cases from East Africa looking at technological changes for the near (year 2020) and more distant future (2030–50). Apart from closing data gaps and carrying out specific model improvements, the way ahead for modelling technological innovations lies in multi-scale integrated analysis with more attention and proper linkages to the farm household level.

Keywords: Adaptation, Africa, agricultural systems models, climate risks, food security, technological innovation

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