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Modelling Impact of Climate Change on Agricultural Food Production in sub-Saharan Africa and Measures of Mitigation

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Abstract

Several recently published studies have shown that climate change will very likely have a significant impact on the global agricultural production. While an increase in agricultural yields is expected in temperate zones, crop yields are supposed to decrease even further from already low levels in (sub-)tropic and (semi-)arid regions of sub-Saharan Africa. Our study makes use of a regionalised large-scale crop growth model based on the GIS-Environmental Productivity Integrated Climate (GEPIC) model. The regionalisation can provide more precise estimations of future yield change than global models with very general parameter setups. For this, global soil data will be adapted to more realistic conditions and local agricultural practice will be taken into account as far as possible. A global circulation model (GCM) ensemble consisting of 4–5 GCMs will be applied to assess the likeliness of decreases and increases in yields.

Preliminary results from the model without regionalisation have shown that yields of the staple foods maize, wheat, and rice will be affected to different extents. For maize an increase in yields can be expected along the east African coast, southern Africa, and the Gulf of Guinea. This can be attributed to the heat tolerance of the crop, increasing CO₂ concentrations in the atmosphere, and local increases in precipitation. In the Sahel zone and Central Africa, losses are very likely, though. Wheat and rice will mostly be negatively affected, while the most severe losses can be expected for wheat in the Sahel countries.

Besides the sole assessment of climate change impact on agricultural production, different strategies for climate change mitigation will also be tested using the same model. Thereby, investment intensive technologies like irrigation and industrial fertilisers will be compared with low-cost techniques like rain water harvesting and ecologic sanitation. Also crop suitability under current and future environmental conditions will be an objective of the study.

Keywords: Climate change mitigation, crop growth modelling, food security, GEPIC