Quantifying trade-offs between food security and biodiversity under climate change conditions

Florian Zabel[*1], Ruth Delzeit[*†2], Wolfram Mauser[‡1], and Gernot Klepper[§2]

[1]Ludwig-Maximilians-Universität [München] (LMU) – Germany
[2]Kiel Institute for the World Economy – Hindenburgufer 66 D-24105 Kiel, Germany

Abstract

The trade-off between providing sufficient quantities and qualities of food in the future, and sustaining ecosystems and their services are driven by various biophysical and socio-economic global and local parameters and assumptions. With a world population that is expected to grow from currently about 6.9 billion to 9.2 billion by 2050, as well as changing lifestyles and consumption patterns towards more protein containing diets, the Food and Agricultural Organization (FAO) estimates that meeting the world's food demand requires a 70% increase in total agricultural production. Land productivity considerably increased over the last 6 decades, since in this period the food production was doubled while agricultural land only increased by 10%. However, agricultural yields as well as production stability is threatened by a changing climate. Besides intensification, land expansion constitutes another possibility to reach higher production quantities. With rising demand for different uses of biomass, land use changes and the expansion of farming areas into natural habitats may threaten ecosystems and their services. Food supply for instance does not only depend on the ability to produce a sufficient quantity and quality of food, but also on the food price level. Changes in agricultural productivity are driven by regional factors, but at the same time agricultural productivity is also driven by economic factors such as the profitability of certain crops in certain areas. To take these drivers into account, we use an approach that includes various biophysical as well as socio-economic global and local parameters. We combine a high spatial resolution bio-physical crop growth model with a computable general equilibrium (CGE) model to simulate agricultural production potentials, compute the profitability of expanding agricultural land in a certain area as well as feedbacks on global agricultural markets which in turn affect agricultural profitability and therefore land use. The approach allows for identifying global hot spots of land use/cover change as well as price changes of food sectors under different scenario setting. Our results show that an expansion of agricultural land into grassland is not profitable on the global scale.

[*]Speaker
[†]Corresponding author:
[‡]Corresponding author:
[§]Corresponding author: