THE IMPACTS OF GLOBAL LIVESTOCK PRODUCTION ON LAND USE CHANGES AND FOOD SECURITY: THE POTENTIAL CONTRIBUTION OF ORGANIC AGRICULTURE

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Global population is forecasted to increase from 7 to 9 billion people by 2050 resulting in a doubling of meat consumption if current trends persist. This raises the question whether current production methods will succeed in producing sufficient meat in order to feed the projected world population and how and to which extent the required structural changes of the different livestock production systems affect economic, social and ecological dimensions of land system changes, including food security issues The dynamic inter-linkages between livestock and the overall biomass production and consumption system are highly complex, and livestock systems directly and indirectly link to many urgent sustainability problems such as food security, biodiversity loss, natural resource depletion and climate change. In order to improve the current understanding of the interrelations between these factors, including their feedbacks, integrated, comprehensive approaches are urgently required. This paper presents such an empirical analysis, focussing on the trade-offs and constraints in the global biomass production-consumption system, with particular attention to organic livestock systems.

This paper presents a biophysical scenario analysis at the global scale for 2050, based on large and consistent data bases on land use, socioeconomic and ecological biomass flows for the year 2000, and a consistent set of assumptions on trajectories of technological, land use and climate change for 2050, derived from expert guesses and the literature. On the basis of a biomass-balance model, the equilibrium between global biomass demand (food and fibre) and global biomass supply from crop and grazing land for 11 world regions, 11 food categories, seven food crop types and two livestock categories as well as a global bioenergy potential from cropland and grazing areas (forestry is beyond the scope of this study) is calculated. In addition, the possible effect of climate change on yields using a coupled plant growth and water balance model (LPJmL) is estimated. The FAO projections of world agriculture in 2050 are used as a baseline scenario, where crop yields are forecasted to increase by 54% on average and cropland area by 9%. This is compared with other crop production scenarios, taking altered agricultural yields and livestock feeding efficiencies related to organic crop production explicitly into account. The effect of different global diets, ranging from 'western high meat' (high calorie, rich in animal protein) to a nutritionally sufficient diet standard with drastically reduced availability of animal products, are assessed. The systematic combination of assumptions resulted in a range of scenarios, each of which is classified as 'feasible' if calculated cropland demand can be sustained by cropland availability in 2050.

The empirical results illustrate the option space of organic agriculture, in particular organic livestock production systems, for feeding the planet sustainably, fairly and humanely. We find that organic farming has a high potential to provide sufficient food for the growing world population, but might not allow sustaining a Western type diet, rich in calories and proteins from animal sources. According to our results, climate change could have a positive or a negative impact on the global food and bioenergy

system: In the absence of a CO2 fertilization effect, climate change could have a significant negative impact on food and bioenergy

provision, whereas the effect could also be strongly positive if the CO2 fertilization effect was fully taken into account. Depending on the outcome of these two extremes, the option space for organic agriculture will be either significantly smaller or larger.

Increases in yields are found to be highly prone to be overcompensated by surges in demand for agricultural products. In particular, the amount of bioenergy that can be produced under an organic farming scenario is, even with frugal diets, drastically smaller than many, broadly accepted, estimates of future bioenergy potentials. Largest bioenergy potentials are found in Southern America and Sub-Saharan Africa. Thus, particular attention is paid to these regions of the global South, where, due to unstable regimes and a lack of financial means, governments cross difficulties in having the potential for agricultural intensification, and a current precarious food security situation persists.

In conclusion, our findings suggest that isolated policies, which aim at increasing agricultural efficiency or yields and are not associated with policies aimed at a more sustainable consumption (level) are prone to feedback loops in the consumption system (rebound effects) that counterbalance the intended effects.