

## Accepted Manuscript

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PII: S0921-8181(17)30148-0  
DOI: doi:[10.1016/j.gloplacha.2017.10.002](https://doi.org/10.1016/j.gloplacha.2017.10.002)  
Reference: GLOBAL 2656  
To appear in: *Global and Planetary Change*  
Received date: 5 April 2017  
Revised date: 8 August 2017  
Accepted date: 11 October 2017

Please cite this article as: Isabelle Weindl, Alexander Popp, Benjamin Leon Bodirsky, Susanne Rolinski, Hermann Lotze-Campen, Anne Biewald, Florian Humpenöder, Jan Philipp Dietrich, Miodrag Stevanović, Livestock and human use of land: Productivity trends and dietary choices as drivers of future land and carbon dynamics. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Global(2017), doi:[10.1016/j.gloplacha.2017.10.002](https://doi.org/10.1016/j.gloplacha.2017.10.002)

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## Livestock and human use of land: productivity trends and dietary choices as drivers of future land and carbon dynamics

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**Abstract.** Land use change has been the primary driving force of human alteration of terrestrial ecosystems. With 80% of agricultural land dedicated to livestock production, the sector is an important lever to attenuate land requirements for food production and carbon emissions from land use change. In this study, we quantify impacts of changing human diets and livestock productivity on land dynamics and depletion of carbon stored in vegetation, litter and soils. Across all investigated productivity pathways, lower consumption of livestock products can substantially reduce deforestation (47-55%) and cumulative carbon losses (34-57%). On the supply side, already minor productivity growth in extensive livestock production systems leads to substantial CO<sub>2</sub> emission abatement, but the emission saving potential of productivity gains in intensive systems is limited, mainly due to trade-offs with soil carbon stocks. If also accounting for uncertainties related to future trade restrictions, crop yields and pasture productivity, the range of projected carbon savings from changing diets increases to 23-78%. Highest abatement of carbon emissions (63-78%) can be achieved if reduced consumption of animal-based products is combined with sustained investments into productivity increases in plant production. Our analysis emphasizes the importance to integrate demand- and supply-side oriented mitigation strategies and to combine efforts in the crop and livestock sector to enable synergies for climate protection.

**Keywords:** livestock productivity; diets; land use; deforestation; carbon emissions; greenhouse gas mitigation

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