Submitted Abstract

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Title	Agroforestry Trade-Offs Between Biomass Provision And Carbon Sequestration In The Alpine Ltser Region Eisenwurzen, Austria.
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Abstract

Mountain agroecosystems deliver essential ecosystem services, but are prone to climate change as well socio-economic pressures, making multi-functional land systems increasingly central to sustainable mountain land-use policy. Agroforestry, the combination of trees with crops and/or livestock, is expected to simultaneously increase provisioning, regulating and supporting ecosystem services, but knowledge gaps concerning trade-offs exist especially in temperate industrialized and alpine regions. Here we quantify the above-ground carbon (C) dynamics of a hypothetical agroforestry implementation in the Austrian Long-Term Socio-Ecological Research (LTSER) region Eisenwurzen from 2020–2050. We develop three land-use scenarios, integrate data from three distinct land-use models (Yield-SAFE, SECLAND, MIAMI) and advance the socio-ecological indicator framework Human Appropriation of Net Primary Production (HANPP) to assess trade-offs between biomass harvest and carbon sequestration. Results indicate that agroforestry strongly decreases HANPP because of a reduction in biomass harvest by up to -71% and a simultaneous increase in actual net primary production by up to 31%, with a high share of carbon sequestered in perennial biomass by up to 3.4 t C ha-1 yr-1. This shows that a transition to agroforestry in the Eisenwurzen relieves agroecosystems from human-induced pressure but results in significant trade-offs between biomass provision and carbon sequestration. We thus conclude that while harvest losses inhibit large-scale implementation in intensively used agricultural regions, agroforestry constitutes a valuable addition to sustainable land-use policy in alpine regions, particularly on extensively managed grasslands.