AGROFORESTY TRADE-OFFS BETWEEN BIOMASS PROVISION AND ABOVE-GROUND CARBON SEQUESTRATION

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BACKGROUND

• Traditional meadow orchards (“Streuobstwiesen”) were abundant in the Eisenwurzen region, providing food, feed and fibre as well as biodiverse-rich habitats. Socio-economic drivers led to the quasi-disappearance of this land-use system during industrialization of agriculture in the 20th century.

• Meadow orchards are typical agroforestry systems: a combination of woody vegetation with crops and/or livestock on the same unit of land. They are integrated, multi-functional land-use systems, with large potentials for mitigating and adapting to climate change, combating biodiversity loss, erosion and eutrophication.

• Recent activities in the region aim at maintenance, rejuvenation and replanting of meadow orchards, preserving old and rare fruit tree varieties, supporting harvesting, processing and marketing of “Streuobst” products, and promoting its cultural heritage for tourism.

METHODOLOGY

• Definition of a prototypical agroforestry system assuming the integration of 80 wild cherry trees (Prunus Avium L.) per hectare, applied to all available crop- and grasslands in the study region.

• Simulation of plot-scale growth dynamics in arable and agroforestry systems (2020-2080) using Yield-SAFE model [1], parameterized with local soil data (eBOD) and climate projections (RCP4.5).

• Upscaling of plot-scale growth dynamics to the landscape-scale using simulations of future land-use change from SECLAND model (2020-2050) [2], based on the decision-making of agricultural actors under the SSP1 pathway.

• Quantifying the carbon dynamics using an extended version of the HANPP framework, representing fluxes of net primary production (NPP-act) to account for the amount of carbon appropriated by humans [3].

• Comparison of land-use scenarios using conventional agriculture as a baseline scenario (AGR), differentiating between a gradual agroforestry implementation between 2020-2045 (AFS-GRAD), and an immediate agroforestry implementation in the year 2020 (AFS-IMM).

RESULTS

• A hypothetical transition to agroforestry in the Eisenwurzen significantly decreases human-induced pressure on the agroecosystem, but results in significant trade-offs between biomass provision and carbon sequestration.

• The carbon sequestration potential is comparably high but monetary remuneration for non-provisioning ecosystem services is required to counteract socio-economic burden of implementation.

• Yield loss for crops and grass is attenuated by cherry fruit production but may inhibit large-scale implementation on intensive agricultural plots, but trade-offs are less severe on extensive grasslands.

SCIENTIFIC OBJECTIVES

• Explore the biophysical option space for a landscape-scale implementation of agroforestry in the region.

• Quantify the above-ground carbon dynamics of a business-as-usual and two agroforestry scenarios between 2020-2050 (resp. 2020-2080).

• Focus on the trade-offs between “biomass provision” and “carbon sequestration” to highlight a potential conflict between climate change mitigation and the provision of food, feed and fibre.

References