



Land-use change and climate change mitigation potential of agricultural soils in Finland

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We aimed to estimate a nation-wide potential to improve the carbon balance of the land use sector by removing part of the current croplands on mineral soil from food and feed production to extensive grasslands or afforestation in Finland. We combined the existing data on forest and agricultural production, and climate with predictive capacity of YASSO07 soil carbon model to estimate changes of soil carbon stock (SOC) in Finland over the past land use change (LUC) from forest to agriculture in comparison with alternative LUC or continuous agriculture in future.

The model analysis revealed that SOC loss after deforestation during the cultivation period originated mainly from the absence of woody litter input. The non-woody litter input of the forest was comparable to that of the agricultural residues thus the SOC originating from non-woody litter has not changed much during cultivation. The model estimated approximately a 30 year delay in positive soil carbon balance after the afforestation. Longer for Norway spruce than for the Pubescent birch. The comparison of two dominant tree species used for afforestation highlighted a difference in soil versus biomass carbon sequestration. The total forest biomass production and total carbon stock was larger for spruce stands than for birch stands. However, due to larger foliar and fineroot litter input birch stands sequestered more carbon into the soil than spruce stands. The analysis further revealed that extensification of cropland to grassland would not meet 4 per mill soil carbon sequestration criterion needed for achieving Paris climate CO₂ reduction target and due to the spatial limitation of afforestation other management measures need to be considered e.g. adding biochar to soils for successful and more permanent CO₂ offsetting.