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Shifting towards more organic cereal production: estimation of expected GHG emissions in Southeast Finland and South Savo using EX-ACT

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Background: The EU's Farm to Fork strategy sets the objective of reaching "at least 25% of the EU's agricultural land under organic farming by 2030" and Finland is still below that threshold. We set out to estimate the expected GHG emissions were the local organic cereal production be increased to 25%.

Methods: EX-Ante C-balance Tool (EX-ACT) was chosen for the assessment. It is a freely available spreadsheet-based approach developed by the FAO, aiming to provide a cost-effective calculation of the impact of agricultural, forestry and fishery projects on carbon-balance. EX-ACT can be used by solely providing data on project activities and relying on recognized default values for emission factors and carbon values (Tier 1) to calculate GHG emissions. Result precision can be increased through region-specific values (Tier 2), if known and available. The choice of using EX-ACT for the case study was two-fold: (1) to see the appropriateness of its Tier 1 results, and (2) to showcase a use for ARMOSA model results for Tier 2 refinement [the model is presented in a separate abstract].

5-year average statistical data was used for harvest areas and yields. Other input values (e.g chemical inputs, machinery use) were based on experimental and literature data. Estimates were calculated for "business-as-usual" (organic production in Southeast Finland and South Savo ELY-centers are 15.3% and 18% of the arable land, respectively), Scenario 1 (overall cereal production area identical, i.e., 75,000 ha, increase to 25% organic production, conventional and organic yields remain the same), and Scenario 2 (as Scenario 1, but organic yields are increased by 10%).

Results: Tier 1 results (that use default values for e.g. rates of soil C seq.) estimate that currently all cereal production in the project area results in soil C sequestration, from field to farm gate (from field preparation to chemical fertilizer production to planting and harvesting). "Business as usual" resulted in -0.1 tCO2eq/ha/yr, Scen. 1 and 2 both -0.4 tCO2eq/ha/yr. This is largely due to the broad management practice categorisations that EX-ACT makes to stay cost-effective and with low data requirements resulting in underestimated CO2 emissions from organic soils.

Tier 2 results estimate that the soil C sequestered by organic fields does not fully compensate emissions originated from the use of fertilizers, fuel, etc. in the studied area. "Business as usual" resulted in +1tCO2eq/ha/yr emitted, while Scen. 1 and 2 both +0.6tCO2eq/ha/yr. These results are

in line with previous LCA studies showing that organic practices can lower emissions but are not sufficient to achieve neutrality by implementing EU's Farm to Fork strategy.

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