



## **Joint spatial assessment of agricultural soils' filtering and provisioning function in Hungary**

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Spatially explicit assessment (quantification and mapping) of soil functions and services is still a challenge. Soil property maps provide quantified spatial information, which can be properly utilized in the spatial inference of soil functions and services. Digital process or crop models properly simulate the soil-plant-water environment conditioned by various factors based on actual, predicted or presumed data. Specific outputs of the modelled processes provide adequate information on certain soil functions. Although these models do not necessarily work in space, they can be built in as engines into spatial inference systems. Once the input is spatialized, the output is also produced in map format.

Council of the European Union has established the Nitrates Directive covering all Member States to avoid nitrate pollution, which is also valid regulation for Hungary. Good Agricultural Practice describes the elements of the protection against nitrate pollution, according to which farmers are obliged to provide data on their nutrition supply each year in areas classified as nitrate sensitive (nearly 70% of the territory of Hungary). From ecosystem service point of view, agricultural soils in these areas provide simultaneously filtering and provisioning functions which are heavily affected by anthropogenic factors realized in their management.

We carried out the agri-environmental assessment of the nitrate database for the year 2016 using the 4M crop model with appropriate spatial soil information provide by DOSoReMI.hu. By the crop production simulation model, the expected yields of the 5 main crops (wheat, maize, barley, sunflower and rapeseed) and the amount of nitrogen uptaken by crops were estimated at total of 1.3 million hectares on 50,000 Agricultural Parcel Identification System (MePAR) blocks. The needed input parameters to model running were supplied by the nitrate database (manure amounts, cultivated crop, and yield) and 100 meter resolution digital soil property maps, in depth of 0-30 cm, 30-60 cm, 60-100 cm, and 100-200 cm (clay, silt and sand and organic matter content aggregated for MePAR blocks).

In view of the total amount of nitrates from nitrate database we estimated the nitrogen balance as well as the nitrate content that leach under the 0-90 cm soil layer. The model also allowed to run different fertilization time scenarios using the year of 2016 nitrate database.

Our results verified that the nutrition of Hungarian agriculture is environmentally friendly, as the fertilizer doses are adapted to the needs of grown plants or in many cases it is under the requisite. In this context, the nutrient balances are negative. We found strong correlation between the adequacy of production site and the amount of used fertilizer, so the agri-ecological possibilities are taken into account by farmers in the planning of nutrient management.

According to results of 4M model runs, we established that the extension of manuring season did not show any significant increase in agri-environmental risk, that is the soil nitrate content under the 90 cm layer do not increase. Based on the results, we suggested to change the relevant regulation, so the beginning of close season should be modified from 31 October onwards 30 November.