

Sustainability in numbers – new method for estimating nutrient stocks and flows in agriculture

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A quantitative model for measuring sustainability in the Finnish agricultural sector has been developed in a new thesis. The new model challenges the OECD method, which is currently used when evaluating areas of potential pollution from nutrients.

Research scientist Natalia Kuosmanen at MTT Agrifood Research Finland says defining sustainability quantitatively is challenging due to variety of meanings attached to this commonly used concept.

"What gets measured gets done, as the saying goes. The same truth applies to sustainability. Can we define sustainability and assess it, if we do not have the exact means to measure it?" Kuosmanen asks.

New frontiers in ecological economy

In her thesis, Kuosmanen used established methods of frontier estimation to evaluate sustainability performance of Finnish dairy farms. The methods are commonly applied for productivity and efficiency analysis in banking and industry.

Moreover, her thesis include a new dynamic approach to model nutrient stocks and flows. The new model was developed in the Finnish agricultural sector, where the stocks and flows of nitrogen and phosphorus were estimated from a 48-year period. It was, furthermore,

applied in the data of 14 EU countries in the period between 1961 and 2009.

Improvements for OECD nutrient balance model

Currently, the static nutrient balance approach of OECD is used to assess nutrient emissions from agriculture.

"The new dynamic nutrient balance model has several advantages compared with the conventional static approaches. The static approach ignores the accumulation of nutrients in the environment and overlooks the dynamic nature of the [nutrient cycles](#)," Kuosmanen says.

Kuosmanen's dynamic model enables the analysis of the development of nutrient stock over time and the distribution of the nutrient flows into water, air and soil. The stocks and outflows from the stock calculated using the dynamic model could be utilized in sustainability assessment as indicators of environmental pressure from agriculture.

When applied to farm and country level data, the results reveal that the nutrient outflows are much more stable over time compared with the net inflows. Currently, the net inflow is widely used as an agri-environmental indicator to support policy making in Europe and in other developed countries.

"Unfortunately, this indicator is sensitive to random fluctuations due to weather, measurement errors and other noise in data, which may result in significant under- or overestimation of the nutrient emissions in short term assessments. Our results demonstrate that the nutrient outflow, calculated using the dynamic nutrient balance model, provides a more reliable and robust indicator for the purposes of evaluating and designing national and the EU-level agri-environmental policies," Kuosmanen argues.

From theory to practice

Kuosmanen began her academic career in Kiev Polytechnic University, Ukraine, and graduated in environmental sciences in Wageningen University, the Netherlands. She is ready to take her results from theory to practice.

"Our dynamic approach would provide better estimations of the [nutrient](#) leaching from agriculture to environment than the conventional method of OECD."

Provided by MTT Agrifood Research Finland

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