

**Session Economy: April 11th 15.45 hrs**

**3S1 Modeling the circular economy with sectoral and macro-economic models**

## **Cost and benefits of options to reduce nitrogen and phosphorus losses at different ambition levels in the Netherlands**

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Inputs of nitrogen (N) and phosphorus (P) have largely increased crop production, but also elevated losses of N and P from the whole food chain. In every step of the food supply chain, from the production of N and P fertilizer towards the N and P intake by humans, there are losses of N and P to air and water, caused by fertilizer and manure application in the field, from manure management systems, via food wastes and during sewage treatment. These losses negatively affect biodiversity and human health and contribute to climate change.

To evaluate the impacts of mitigation scenarios on soil, water and air quality with the related costs and benefits for the agricultural sector, economy and environment, we coupled four models. This included: (i) BIOSPACS, assessing impacts of dietary changes and mitigation options on animal numbers and land use at national scale, (ii) DRAM, calculating changes in animal numbers and land use (crop areas) at regional scale and the costs of the packages for reducing the P and N losses to air and water for the primary agricultural sector, (iii) INITIATOR assessing the impacts of changes in animal numbers and land use and mitigation options on NH<sub>3</sub>, N<sub>2</sub>O and CH<sub>4</sub> emissions to air, NO<sub>3</sub> leaching to ground water and N and P runoff to surface water at local scale and (iv) a cost-benefit assessment (CBA) that focusses on the impacts of reduced N and P pollution on the economy.

The mitigation scenarios with different ambition levels to reduced N and P losses to air and water, were based on the so-called 5 R strategy:

- i. Redefining N and P intake by humans by changing diet, such as a less meat and dairy, and reducing food waste.
- ii. Recycling of N and P in food waste from households, catering and food processing industry and use of seaweed as animal feed, with less external feed import.
- iii. Recycling and recovery of N and P from organic waste streams, especially wastewater, for use as fertilizers.

- iv. Re-align/reduce N and P inputs by increasing the NUE and PUE of feed, manure and fertilizer.
- v. Reducing of N and P losses to air and water by end of pipe measures such as more efficient housing systems and manure application techniques to reduce NH<sub>3</sub> emissions.

In this presentation, we shortly summarize the N and P balance of the Netherlands to identify the most important mitigation options, discuss the identified scenarios with mitigation options that are being evaluated and present the first results of an integrated model evaluation, as outlined above.

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*Keywords: nitrogen, phosphorus, mitigation scenarios, model evaluation, cost-benefit assessment*