Developing a new indicator to assess nitrogen efficiency of various farming systems

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Introduction

• Improving N efficiency to increase food production and agricultural sustainability
• Nitrogen use efficiency shows some limitations
• We developed a new indicator to solve these problems
• System N efficiency proves to be a better tool to evaluate N efficiency of farming systems
1.1. Context

- Nitrogen (N) crucial for food production
  40% food from synthetic N fertilizer (Smil, 2002)

- N losses have major negative impacts
  on water, air and soil quality, on biodiversity and human health (Galloway et al., 2008; Sutton et al., 2011)

- Improve N efficiency
  A promising way to conciliate food production and environment preservation (Foley et al., 2011; Sutton et al., 2011; Peyraud et al., 2012)
1.2. Nitrogen efficiency indicator

- Nitrogen Use Efficiency (NUE)
- \( \text{NUE} = \frac{\text{N outputs}}{\text{N inputs}} \)

Some limitations (Schröder et al., 2003)

**Diagram:**
- **N inputs** (feed, fertilizers, animals, seeds, biological fixation, deposition...)
- **Farm**
- **N outputs** (crops, animal products, manure)
2.1. Perimeter of NUE and SyNE

**Diagram Description:**
- **NUE** perimeter includes inputs and outputs.
- **SyNE** perimeter encompasses the same but with additional considerations.
- **Outputs:** Net animals, Net milk, Net HP crops, Net LP crops, Δstock soil N.

**Key:**
- **HP:** high protein
- **LP:** low protein

**Legend:**
- Indirect losses
2.2. Calculating NUE and SyNE

- Sample: 38 mixed farms, Brittany
- Comparison of the results for both indicators
- Sensitivity analysis for input and output variables of NUE and SyNE
3. Comparison of NUE and SyNE

Average NUE = 0.39
Average SyNE = 0.32
4.1. Interests of SyNE

1. More precise estimation of N efficiency at system scale
2. Allows more relevant comparisons between farming systems
3. Expresses the efficiency of conversion of inputs into end products
4. Change in soil N stock is the most influential variable on SyNE
4.2. Discussion

- Soil N modeling and uncertainty
- Status of outputs
- Efficiency complementary with N balance
- How to compare different systems?
5. Conclusion

- SyNE corrects NUE limitations
- Useful to compare similar systems
- How to compare different systems?
Thank you for your attention.