Nutrient balance at chain level: a valuable approach to benchmark nutrient losses of milk production systems?

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Global consumption of meat and dairy products to increase by 82% between 2000 and 2050 (466 million tonnes of milk)

Various Environmental problems e.g. eutrophication, acidification (production↑ environmental pressure↓)

Environmental assessment method:
Nutrient Balance (farm level, N&P)
Nutrient balance

**Off-farm**
Feed production

- e.g. fertilizer, concentrates, roughage

**Dairy farm**

Nutrient Input

- e.g. milk, meat, manure

Nutrient Output

**Losses**
Research question

Does a nutrient balance at chain level (i.e. cradle-to-farm-gate) provides more insights than a nutrient balance at farm level when comparing different farming systems/individual farms?
Data

Dairyman specialised farms (2010)

-- 19 grass-based Irish farms (IR)
    Self-produced feed (on-farm)

-- 13 concentrate-based Dutch farms (NL)
    Purchased feed (off-farm)
System boundaries

Non-dairy purpose usage (e.g. human consumption, bio-gases)

Input
- Deposition
- Fixation
- Organic fertilizer
- Synthetic fertilizer

Off-farm
- Crop
- Soil
- Processing
- Concentrate
  - Bedding materials
  - Roughage
- Purchased animals

On-farm
- Milking cow
- Young stock
- Manure
  - Crop
  - Soil

Output
- Milk
- Cows
- Calves
- Manure
- Crop

Nutrient balance at farm level
Nutrient balance at chain level
Methodology

-- N and P losses at farm and chain level for each farm kg nutrient losses/ton fat & protein corrected milk

-- Regression analysis
• Farm level & chain level
• Binary variable for country (Ireland, Netherlands)
• Intercept difference
• Slope difference
## Results (N)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Per ton FPCM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IR Mean (SD)</td>
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<tr>
<td>N losses (kg N)</td>
<td></td>
</tr>
<tr>
<td>On-farm</td>
<td>20 (4.3)</td>
</tr>
<tr>
<td>Off-farm</td>
<td>2 (0.9)</td>
</tr>
<tr>
<td>Chain</td>
<td>22 (4.5)</td>
</tr>
</tbody>
</table>
Results (N)

- Regression

Irish farms Vs Dutch farms

Intercept (different)

Slope (no difference)
Farms are ranked by increasing N losses at farm level
## Results (P)

<table>
<thead>
<tr>
<th>Indicators</th>
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<tbody>
<tr>
<td></td>
<td>IR Mean (SD)</td>
<td>NL Mean (SD)</td>
<td>Mean difference (p)</td>
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<tr>
<td>P losses (kg P)</td>
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<tr>
<td>On-farm</td>
<td>0.3(0.4)</td>
<td>0.1(0.2)</td>
<td>0.2(0.57)</td>
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<tr>
<td>Off-farm</td>
<td>0.6(0.3)</td>
<td>0.9(0.2)</td>
<td>0.3(0.00)</td>
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<tr>
<td>Chain</td>
<td>0.8(0.6)</td>
<td>1.0(0.3)</td>
<td>0.2(0.36)</td>
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</table>
Results (P)

- Regression

Irish farms VS Dutch farms

Intercept (different)

Slope (tend to differ)
Results ranking (P)

Farms are ranked by increasing P losses at farm level
Conclusion

- A nutrient balance at farm level:
  - benchmark systems
    1. on-farm losses between systems are large
    2. off-farm losses are relatively unimportant.
  - benchmark individual farms
    changes in off-farm losses per unit change in on-farm losses are similar across farms.

- A chain level balance of a sample set is required to verify these conditions

Comments Suggestions Questions?

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