Evaluating the role of precision nutrient management on grass based dairy farms

PHILIP MURPHY 1,3
PAUL N. C. MURPHY 1 & DAVID P. WALL 2

1Trocaire, Agricultural Catchments Programme, Johnstown Castle, Wexford, Ireland
2School of Agriculture and Food, University College Dublin
3email: phil.murphy@trocaire.ie

Summary
- On grass based dairy farms large variability in nutrient use efficiency exists at field scale.
- This study investigates the drivers of nutrient balances at the farm, field and soil scale (see below).
- To improve nutrient use efficiency (NUE) on farms, fertilizer planning needs to consider important soil characteristics such as, soil type, slope and drainage class.
- Nutrient balances can be used to indicate nutrient surplus or deficit, and therefore offer the opportunity to improve NUE over time.

Introduction
- Soil quality and soil fertility underpin productive & profitable farming systems.
- There is increasing pressure on farmers to increase the agronomic, economic and environmental sustainability of their farm system.
- Enhanced nutrient efficiency is critical for meeting these seemingly opposing targets.
- Large fertilizer requirements on grass based dairy farms has the potential to reduce profitability and sustainability if poorly targeted to fields using blanket application approaches.
- Calculating field or paddock scale nutrient budgeting provides important information on how nutrients should be managed spatially within the farm gate.
- Large variability in soil type, landscapes and weather has the potential to reduce NUE.

1. Farm scale

Nitrogen balance: Farm versus Field scale

<table>
<thead>
<tr>
<th>Kilograms N per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm scale</td>
</tr>
<tr>
<td>Field scale</td>
</tr>
<tr>
<td>362</td>
</tr>
<tr>
<td>201</td>
</tr>
<tr>
<td>119</td>
</tr>
<tr>
<td>-38</td>
</tr>
<tr>
<td>-113</td>
</tr>
</tbody>
</table>

Methodology
- Soil and herbage samples were taken from each field on 23 farms during 3 growing seasons between 2015-2017.
- Nutrient, application and herbage production measurements were recorded per field also.
- Nutrient balances were calculated at the farm scale and the field scale as follows:
  - Nutrient Balance = Nutrient Inputs - Nutrient Off-takes
  - Nutrient inputs: nutrient in fertilizer, manures, concentrate feed
  - Nutrient off-takes: nutrients in milk, meat and slurry/hay

Results and Conclusion
- Results show that nitrogen balances were affected by soil drainage type. A high balance value indicates that there is surplus N not recovered by the grassland and increased potential for N losses to the environment.
- This study also shows that soil P retention was different across soil types due to AI & Fe content affected phosphorus balance.
- This study has identified a range of biophysical and management factors that effect nutrient use efficiency on grassland farms. These factors should be considered when planning fertiliser applications in order to improve nutrient use efficiency on these farms.

2. Field scale

Map of Phosphorus Index

Nitrogen balance per soil drainage class

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Number of nitrogen per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well drained</td>
<td>156</td>
</tr>
<tr>
<td>Moderately drained</td>
<td>143</td>
</tr>
<tr>
<td>Poorly drained</td>
<td>116</td>
</tr>
<tr>
<td>Very poorly drained</td>
<td>113</td>
</tr>
</tbody>
</table>

3. Soil specific scale

Farm map showing soil type differences

Soil Nutrient status

Soil type distribution

Stocking rate