2.3. Precision Nutrient Application

Summary: The basics for precision nutrient application is to determine farm's nutrient balances (at the farm gate, field and stable level). The balances are usually calculated for nitrogen (N), phosphorus (P) and potassium (K). The ideal situation is that the value of the field balance is close to zero, which means that the nutrient uptake of plants and the supply by fertilization are in ideal balance.

Operation and Applicability: All farms can implement some aspects of precision application practices. The 4 R's principle means that right rate, source, application method and application timing will provide proper amount of nutrients to the crop where and when it is needed.

Efficiency: Farm gate balances on farms around the Baltic Sea show that nutrient surpluses can be reduced effectively with precise application and farming techniques. Balanced saldo (+/- 20 kg N/ha around zero) indicates a good status.

Efficiency and functionality Costs of the Practice Ease of Operation Potential for nutrient recovery

The soil surface balance:

- The soil nutrient balance is the difference between nutrient inputs to the field (fertilizers, seeds, biological fixation, atmospheric deposition) and nutrient uptake by plants.
- Nutrient amounts in organic amendments can be analyzed chemically or standard values can be used. The nutrient contents of fertilizers are provided from the manufacturers.
- N_2 biological fixation should be taken into account in calculations.

Farm gate balance:

- Nutrients to the farm (seeds, seedlings, feed, new animals, fertilizers)– Nutrients from the farm (milk, meat, eggs, grain, manure, sold animals).
- The farm balance is counted for one calendar year at a time. However, balances should be calculated for several years to get a good idea of the nutrient flows and the overall view of the nutrient use efficiency on the farm.
- Weather conditions affect also on nutrient balances.

Achieved environmental benefits:

- Fertilizer application and nutrient runoffs are reduced.
- Crop yields are improved and even.
- NH_3 and N_2O emissions and volatilization can be reduced.

Appropriate performance indicators:

- Nutrient use efficiency (nutrient balances)
- P, K and N surplus
- Soil mineralizable N
- Crop nutrient use efficiency
- Utilization of available nutrient content of manures and other organic amendments

Costs of the Practice: Equipping a farm for precision farming is around 2,5 -21,5 €/ha, depending a lot on the complexity of the overall system and farm size.

Ability for climate chance mitigation: By implementing a precision nutrient management planning, it is possible to improve efficiency and effectiveness of nutrients and thus minimize nutrient losses from fields as runoffs as well as NH_3 and N_2O emissions.

Potential for nutrient recovery: The permitted maximal N surplus is set at 60 kg N/ha.

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Evidence of Success: Example of precision farming

Precision farming means field management by means of IT-solutions to optimize agricultural production with lower costs and environmentally-friendly. Technology utilizes satellite positioning systems (GPS technology), yield and soil mapping and remote sensing devices to provide needed information.

Example: N-sensor

- The N input requirements of crop vary between fields and within fields. The lack of N reduces the level of chlorophyll. The N-sensor identifies these changes based on light reflectance and calculates the needed fertilizer dosage. The sensor sends a signal to the spreader sprayer rate controller, which in turn adjusts the precise level of application.
- Finances: the price of the passive N-sensor is around 19 000 € (2011), but it is also possible to contract different packaged services. The economic advantage with N-fertilization by an N-sensor is 50-100 €/ha in cereals.

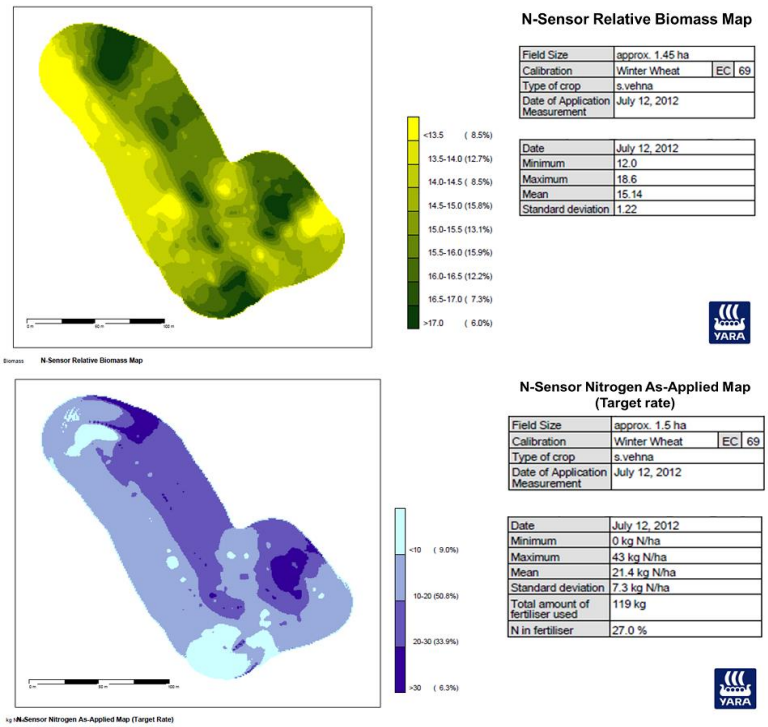

Photo: Example on relative biomass and N target mapping created by the YARA-sensor. (http://www.yara.fi/lannoitus/tyokalut-asiakastakuut/n-sensor/kartat)

MORE INFORMATION:
http://www.balticdeal.eu/measure/nutrient-balance/
https://portal.mtt.fi/portal/page/portal/kasper/pelto/peltopalvelut/fosforilaskuri
https://www.mtk.fi/MTK_english/Agriculture_in_Finland/en_GB/Agriculture_in_Finland/

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