

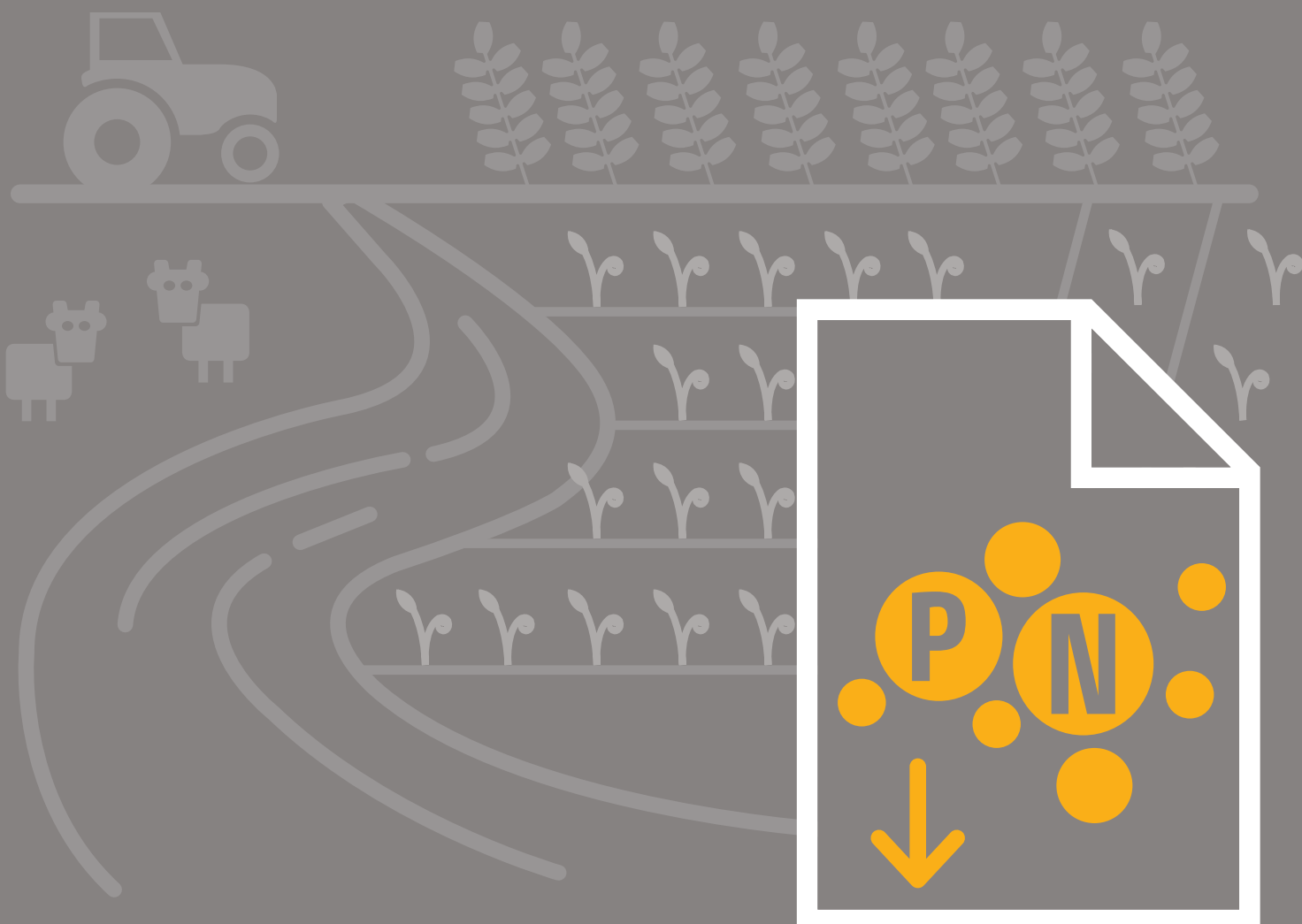
# Guidelines on Fertilisation Planning and nutrient accounting

  
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## Guidelines on fertilisation planning and nutrient accounting

Crop targeted and balanced fertilization is necessary for optimal plant nutrition and at the same time to reduce environmental impacts. Loss of nutrients from farms in the catchment of the Baltic Sea is a major ecological challenge contributing to eutrophication. Therefore, the aim of this document is to give recommendations for the countries to guide or regulate fertilisation planning and nutrient accounting at farm level to reduce nutrient surplus and the risk of nutrient losses, especially to support countries to implement the following Baltic Sea Action Plan (BSAP) actions:

- E7 Balance fertilization rates site-specifically and promote precision fertilization practices to improve nutrient use efficiency and reduce nutrient losses.
- E17 Agree on the national level by 2023 on measures to reduce nutrient surplus in fertilization practices to reduce nutrient losses.
- E31 Create legal and institutional tools to advance towards introducing annual field-level fertilization planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) as a requirement for all farms in the Baltic Sea Region to reduce nutrient surplus on farmlands to the highest possible degree in a cost-effective way.

According to the criteria for achievement, the implementation of these actions requires that there is agreement on national level on measures, legal or institutional tools, relevant national legislation or support scheme in place.

Fertilization planning and nutrient balancing (farm-gate) inherently offer different perspectives on nutrient management on the farm: fertilization planning, as the name implies, is performed at the farm before fertilization for each crop and each field in order to limit N and P excesses through needs-based application. Nutrient balancing of N and P inputs and outputs using the farm gate principle is carried out for the whole farm, including livestock, for the past defined reference year. Therefore one method looks at the field level, the other method looks at the whole farm level.

This document focuses on nutrient accounting for nitrogen and phosphorus, although nutrient accounting can also be done for other nutrients.

## Fertilisation planning

To reduce nutrient surplus and to increase nutrient use efficiency it is important to adapt fertilisation to the yield potential, to the amount of nutrients to be removed in the harvest as well as to the amount of plant available nutrients in the soil.

Nitrogen fertilisation should be planned on a yearly basis before the start of the growing season, but phosphorus fertilisation can be planned for a whole crop rotation instead of annual planning. It is left to the countries to decide which calculation period is more appropriate.

### Important factors to be considered in fertilisation planning

- Rules/legislation that limit allowed amount of nutrients, or fertiliser types, spreading times, and methods.
- Sampling the soil to produce a soil map or database with information regarding soil phosphorus status and pH of the fields. It is useful if also further information is included, e.g., nitrogen, soil texture, organic carbon/matter content, and status of other plant nutrients. The fertilisation is adapted to variations between and within the fields based on available information.
- Nitrogen and phosphorus fertilisation needed by crops depend on:
  - o Crop type, expected plausible yield and intended use of yield.
  - o Crop rotation, pre-crop effect and plant-available nutrients in soil.
  - o Biological nitrogen fixation by plants.
  - o Soil organic matter content.
- Fertiliser application. Factors to consider include:
  - o Available nutrient sources to be used: organic fertilisers (e.g., manure and other organic materials) or mineral fertilisers.
  - o Does the composition of the fertilizer meet the needs of the crop or is additional fertilisation required?
  - o Available spreading techniques, incl. precision farming.
  - o Timing of nutrient spreading to reduce losses and increase nutrient use efficiency.
  - o Adjustment of nitrogen fertilisation to conditions for the specific year and field (split application).
  - o Phosphorus fertilisation annually or at one time for several years.

## Nutrient balance calculation

Nutrient balance calculations at farm or field level should be used in farm management as a tool to better understand and evaluate nutrient use efficiency, as well as to steer towards reduced nutrient surplus and reduced risk of nutrient losses. The nutrient balance calculation after harvest can be made at different scales. Farm-gate balance is better at providing the larger scale holistic picture, including animal husbandry, while field balance gives details necessary to pin-point the exact problem on each field and for each crop. The countries around the Baltic Sea region may choose which method is to be used.

The balance calculation should be made for the main nutrients and usually include calculations at least for nitrogen and phosphorus. The balance is often expressed in kilograms N or P per hectare/farm and year. The balance calculation can be made every calendar year or every crop year. The latter may be more suitable for field level calculation. There can be large differences in the balances between years, e.g., due to weather conditions. So, it is important to follow the balances and their development over the years and preferably to look at least at a three-year moving average. Information from the field balance calculation can be directly used in fertilisation planning for the following years. The nutrient balance is often considered to roughly indicate the risk of nitrogen and phosphorus losses. Changes in stocks (e.g., manure, fodder, livestock, commercial fertilisers) are accounted for in some farm-gate balance calculation methods. Different forms of losses, such as losses from storage or fertiliser spreading, are estimated and included in some calculation methods. It is important that the differences between calculation methods are taken into account when interpreting the results, especially when different balances are to be compared with each other.

### Farm-gate balance

The farm-gate balance is calculated as nutrient inputs to the farm minus nutrient outputs from the farm. It gives an overview of the nutrient efficiency on the farm. The farm-gate balance is easy to communicate and control and important for a quick holistic picture. However, this balance method does not allow any conclusions to be drawn about, for example, fertilization errors or specific loss paths; more extensive analyses are required for this purpose.

Nutrient inputs to the farm include:

- All nitrogen and phosphorus that enter the farm with purchased feed, live animals, seeds, organic fertilisers (e.g., imported manure and other organic material) and mineral fertilisers. It is left to the countries to decide on choosing between field and farm level balance sheets.
- Atmospheric nitrogen deposition, if available.
- Biological nitrogen fixation by crops.

Nutrient outputs from the farm include:

- All nitrogen and phosphorus that leaves the farm, for example in plant products (e.g., cereals, straw, roughage, vegetables and oil seed crops), in animals and products from animals (e.g., milk, meat and eggs), and exported manure.

The N and P content of all products is not measured or reported. In this case, average values from the literature can be used.

Field balance

The field balance is calculated as the difference between nutrient inputs to the field and nutrients removed with the harvest. The field balance gives more specific information about nutrient use in fertilization, but it can be problematic to get exact values on yields and on nutrient content in the yield. In addition, the field balance does not fully incorporate animal husbandry, because e.g. no statement can be made about the nutrient balance of feeding. Field balance, as the name implies, is purely a fertilizer balance at the field level. And as a supplement to the farm gate balance, an option to get to the bottom of balance surpluses at farm level (farm gate balance) at field level.

Nutrient inputs to the field include:

- Nitrogen and phosphorus added to the crop/field, for example with mineral fertilisers and organic fertilisers (e.g., manure and other organic material).
- Biological nitrogen fixation by crops.

Nutrients removed from the field include:

- Nitrogen and phosphorus in harvested crops (e.g., cereals, straw, roughage, vegetables and oil seed crops).

The field balance is calculated for each field. The phosphorus balance gives an indication of the development of the phosphorus status of the soil over time. If the balance calculation is made yearly and soil mapping is made with regular intervals it can be used as a tool to steer towards an appropriate nutrient status of the fields.

Reference values

It is useful if reference values from similar farms are available. In this case, farmers can better evaluate the efficiency of nutrient use on their own farms. However, it should be noted that the balances must be calculated using the same method when making comparisons. It is known that used methods and nutrients included in calculations vary currently. In addition, a farm gate balance cannot be compared to a field balance. If the nutrient surplus is large compared to other farms with similar production or for one single farm year after year, it suggests that the nutrient use efficiency should be increased.

In principle, an assessment of the balance sheet value must be made in addition to the calculation. This can be done by comparison as a relative evaluation, as described above, or objectively at a balance sheet target value for the corresponding method established on a scientific basis.

## Reporting

When reporting on the national implementation of BSAP actions E7, E17 and E31, the Contracting Parties are also to report on how these guidelines have been taken into use nationally including which nutrient balance method is in use in the country. The reporting on the implementation of national BSAP actions takes place in 2025 and 2029.