REDUCE FERTILISER APPLICATION RATES BELOW THE ECONOMIC OPTIMUM

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Description
Reduce the amount of N and P fertiliser applied to crops by a certain percentage below the economic optimum.

Rationale, mechanism of action
On most fields, limiting the amount of N fertiliser applied to crops will reduce the quantity of residual nitrate in the soil after harvest [1]. In the short term, limiting P fertiliser rates can reduce the amount of soluble P lost from the system through incidental losses [2]. In the long term, reducing P fertiliser rates can potentially reduce both particulate P and soluble P losses through reductions in soil P reserves.
The amount of fertiliser applied is reduced at source. There will be a slight reduction in the amount of residual soil nitrate available for leaching in the autumn [3]. However, there will be no effect on the amount of nitrate mineralised from soil organic matter. This mineralised nitrate forms the larger part of the nitrate pool that is available for leaching over the autumn and winter [4].

Relevance, applicability & potential for targeting
The method is applicable to all farming systems where fertiliser is used, but could have a significant impact on crop yields, depending on the level of percentage reduction. Reductions in N fertiliser would have an immediate impact on all crops other than legumes. For most crops, any reduction in fertiliser N would cause a small but economically significant reduction in yield. For example, for winter wheat, a 10% reduction in fertiliser N (from the economic optimum) would result in a 1 - 3% reduction in yield. For phosphorus, the impact of reducing P_2O_5 fertiliser would be greatest and immediate for crops that are particularly responsive to the nutrient (e.g. potatoes and some vegetable crops). It is important that any reduction in fertiliser use should take account of the interactions between nutrients and not create an imbalance in the soil. A shortage of one nutrient may limit uptake of another and potentially increase losses of this second nutrient.

Effectiveness, including certainty
For nitrate: Arable: A 20-50% reduction in N application below the fertiliser recommended rate would be expected to result in a moderate reduction in nitrate leaching [5].
For total phosphorus: It is estimated that a 50% reduction in P_2O_5 fertiliser input could potentially result in a moderate (around 20%) reduction in the fertiliser component of the baseline loss [5]. The manure and soil components of the baseline loss would be unaffected in the short term.

Time frame
The slight reduction in the amount of residual soil nitrate available for leaching in the autumn will occur in the year of implementation. However, where organic manures are regularly applied to the soil, there will be little net effect from reducing mineral fertiliser rates. In the longer term, where soil P reserves are allowed to run down, there will be a

reduction in soluble and particulate P loss. Limiting P fertiliser applications in any one year will reduce the amount of P that can be lost in surface run-off or in drain-flow.

Environmental side-effects / pollution swapping
If an attempt was made to make up for the reduction in nutrients by increasing the application of organic manures, there would be an increased risk of pollution from nitrate, P, FIOs, BOD, ammonia and ammonium-N.

Administrative handling and control
There would be considerable resistance to the method, due to the impacts on crop yields and the inability to maintain a productive system.

Costs: investment, labor
For winter wheat, a 10% reduction in fertiliser N (from the economic optimum) would result in a 1 - 3% reduction in yield [5]. There would also be significant reductions in yield from a 10% reduction in P_2O_5 fertiliser for those crops that are responsive to the nutrient (e.g. potatoes and some vegetable crops). There would be little impact on the yield of less responsive crops until soil plant available P is reduced to 15 mg/l (Olsen P) or below.
Reductions in P fertiliser would not be expected to reduce grass yields so, in the short term, the method would be expected to achieve cost savings on dairy and beef farms [5].

References
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