IMPROVING SUB-SURFACE DRAINAGE SYSTEMS

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Description
Improving a mal-functioning sub-surface drainage system will decrease the proportion of surface runoff. If water infiltration and flow through the drain trenches will cause sieving of soil particles and phosphorus sorption along the flow routes, soil erosion and dissolved phosphorus losses will be reduced due to the measure. Moreover, improvement of soil structure and better root growth after the operation may be followed by rise in the yield level and lower nutrient balances.

Rationale, mechanism of action
Especially on clayey soils with dense structures in near-surface horizons, sub-surface drainage systems may be fundamental for rapid water flow out of the root zone. A well functioning sub-surface drainage may thus be essential for achieving the full yield potential in climates with excess rainfall. Drain trenches are very conductive and form routes for water which otherwise would be flowing as surface or near-surface runoff towards the lower end of the field. Less surface runoff means lower erosive risk especially at the lower end of the fields. Further, water infiltration increases the potential for sieving of surface-eroded soil particles in soil pores and sorption of surface-derived dissolved phosphorus, before the water flows out of the field.

Applicability
Sub-surface drainage improvement is applicable as a mitigation option for phosphorus losses and erosion especially on clayey soils with problems of surface runoff or excess water in the soil profile at times when field traffic may cause soil compaction (sowing time, growth period, autumn). The action should be targeted for the first place to (1) sites previously compacted and suffering from wetness and to (2) irregular slopes or surfaces with depressions which are often less productive due to low water conductivity or due to receiving extra water from the neighbor areas.

Effectiveness, including certainty
The measure can reduce soil erosion and phosphorus losses depending on (1) the proportions of surface runoff and subsurface drainage flow and (2) the respective concentrations before and after the drainage improvement, (3) characteristics of the soil profile and (4) phosphorus status in the different soil layers. Short-term reductions of 15-25% for soil erosion and dissolved phosphorus losses have been measured but, on the other hand, nitrogen leaching may slightly increase. If the yield level increases due to better root growth, nutrient balances may improve markedly, with long-term positive effects on phosphorus and nitrogen loss potentials. Only very few studies are available on the effectiveness of the measure.

Time frame
See above.

Environmental side-effect/ pollution swapping
Since most of nitrogen leaching is through sub-surface drains on soils with such systems, improving the functioning of the system most probably enhances nitrogen leaching losses. Moreover, nitrogen leaching may increase due to more aerobic conditions favoring nitrification and, simultaneously, decreasing denitrification potential and losses into the atmosphere.

Relevance, potential for targeting, administrative handling, control
The measure is relevant for areas of excess rainfall and soils with low water conductivity. In case of mal-function of the sub-surface drainage system or problems with soil structure, the reasons for the problems should be first investigated and the actions should be then carefully planned in cooperation with professional experts of soil drainage.

Costs: investment, labor and acceptance by farmers
In principal, the measure is well accepted by farmers since it improves soil structure, makes it easier to manage the soil and increases the yield level. However, installing or improving a sub-surface drainage is an expensive operation, which restricts its use especially on rented land.

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