ALLOW FIELD DRAINAGE SYSTEMS TO DETERIORATE / REMOVAL OF TRENCHES AND DITCHES

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Description

Phosphorus (P) is mainly transported to surface water by water. The pathway of the water flow can be changed in such a way that the loss of P-rich components will be reduced by reducing the volume of surface water.

Rationale, mechanism of action

In areas where P losses are mainly caused by subsurface drainage water, management measures are possible to reduce P losses by changing or blocking the pathway of the water flow in such a way that:

- the travel time of the water from a part of the field through the soil to surface water is increased
- and/or the flow rate is reduced

An option to realize this effect is to minimize the subsurface flow to surface water by means of:

- allowing field drainage systems to deteriorate so they gradually lose their function of water drainage (maximum effect at the long term)
- removing trenches and ditches (maximum effect directly / at the short term)

The second option is visualized in figure 1.

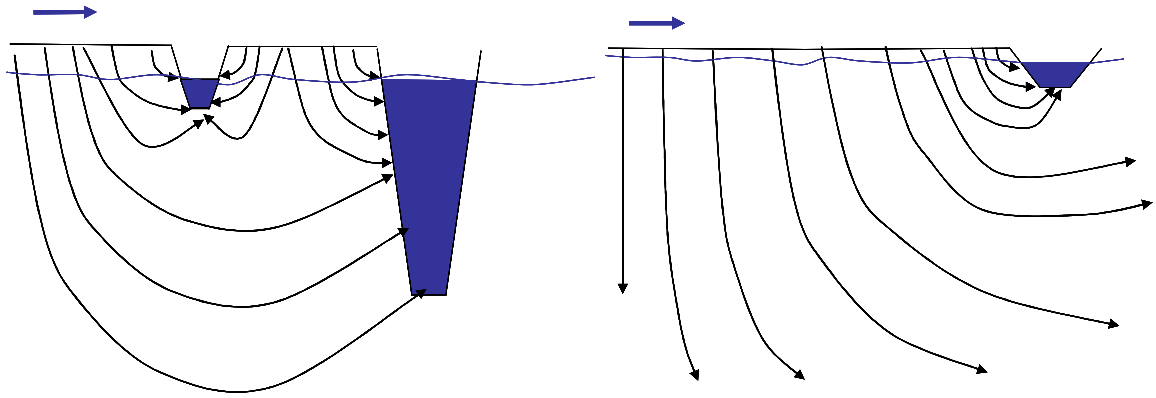

Figure 1. Schematic visualization of the impact of measure "removal of ditches" on the water flow

a) soluble P components

The impact of this measure on losses of soluble P is much better known for inorganic P than for organic P. The general idea of the measure to increase the pathway length of water flow through the soil by reducing the drainage of the precipitation surplus via trenches and ditches. Removing trenching or ditches will have a maximum effect to block this pathway of subsurface leaching completely. Since trenches and ditches are constructed in rather wet areas aimed at discharge of the precipitation surplus to the surface water, the impact of this measure will be that more frequently high groundwater levels will occur. It is important that runoff and erosion events are not increased as a side effect due to too wet conditions and a long time of water saturation of the soil. So, this type of measures will have an impact on a larger area then the fields itself. Therefore such measures should be evaluated at least at sub-catchment level.

In case a precipitation surplus is indeed transported to the surface waters via deeper pathways, P losses will be reduced remarkably. The main reason is that the complete buffering capacity of the subsoil can be used to filter the soluble P from the solution. The impact will increase in case the P sorption capacity of subsoil is large. In most soils the inorganic P equilibrium concentrations are rather low at greater depths. Also the organic P concentrations in the subsoil are lower than in the root zone.

b) particulate P / colloidal P

The P losses caused by transport of detached soil particles containing P through the soil to surface water is not well known in situations without artificial drains. It is expected that also more particulate P will be retained when the pathway length through the soils is increased.

Applicability

The measure will be most effective when applied in field situations where transport by subsurface flow of soluble (in)organic P components contributes to a large extent to the P losses to surface water. Such conditions occur in rather flat areas, deltas or brook/river stream areas and high groundwater levels occur. In those rather wet areas often many trenches are ditches were constructed to drain the excessive amount of water from the fields to the surface water.

Effectiveness, including certainty

The effectiveness of removing trenches and ditches will have the most impact in areas where shallow groundwater levels frequently occur. In flat areas of the Netherlands reductions of 79-89 % have been calculated for fields in sandy areas, in case 90% to 100% percent of the shallow water flow is blocked (Jeurissen and Verhaegh, 1990; Schoumans and Kruijne, 1995). The effectiveness in field studies was not gathered yet. However, some evidence that deterioration of the surface water system had a positive effect on the improvement of the water quality in some studies (Svendsen et al., 1995). It is important to notice that the improvement of the water quality is caused also by other factors such as improvement of the retention because of increasing the residence time in the ditches (Olli et al., 2009).

Time frame

The impact of the measure will be directly in case trenches and ditches are removed and at the mid or long term in situations where the field drainage systems is deteriorated.

Environmental side-effects / pollution swapping

As a result of this measure the top soil will become more wet during the year, especially in autumn and during early spring, since the excess water is not drained via trenches or ditches. A positive side effect is that the nitrate concentration will be reduced because of the wet conditions leading to more denitrification. A negative side effect is that as a result of more denitrification also the emission of gaseous N_2O may increase. The main negatives effects are related to agricultural practices and crop production because the soils can remain wet for a long time. The longer an area remains wet, the higher the risk of crop damage and infection by fungi.

Relevance, potential for targeting, administrative handling, control

The option can be relevant for fields that are the main cause of diffuse P losses by subsurface transport at local scale. Selection of such fields by modeling approaches or by local experiences are highly recommended. Furthermore, runoff and erosion events should be prevented. This can be arranged by increasing the depth of ditches at other places within the sub-catchment in order to drain the precipitation surplus from the sub-catchment as a whole.

Costs: investment, labor

The main costs are caused by labor to remove the ditches and trenches. No special investments are necessary.

References

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