

## **Comparative analysis of phosphorus load reduction measures**

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According to the water quality assessment carried out in Hungary approximately half of the surface water bodies (rivers and lakes) do not meet the criteria of good ecological status because of different types of water pollution (VKKI, 2010). Phytoplankton, phytoplankton and general physico-chemical parameters, which are supporting the biological elements, were used as indicators for nutrient pollution. Most of the cases (35% of water bodies) nutrients, principally phosphate (PO<sub>4</sub>-P) and total phosphorus (TP) concentrations exceed the WFD limit values corresponding good status. Typically, the status of smaller watercourses and ponds is significantly worse than that of the larger rivers and lakes. Discharge of treated waste waters contributes to almost half of the total P emissions to surface waters. Major diffuse P load in the hilly areas attributable to high erosion potential. The nutrient load is significant only in those flatland agricultural fields, from which excess water is drained off, while problems are caused rather by wastewater discharges in the lowland area of the country.

Emission and transport model (Kovács et al., 2008) was performed for the whole country in order to estimate P loads as well as river concentrations. Case study catchments were selected for model calibration and validation. Some of these served as the bases for cost assessment (Clement et al., 2010). Location of potential P source areas with exceeding annual soil loss of 1 mm/ha (approximately 15 kg/ha) and with total annual P load exceeding 2 kg/ha were designated for the application of BMP measures. Annual costs of the different management practices were collected from the “New Hungary Rural Development Plan” (Tar, 2006).

Highest cost-efficiency has the P removal applied at WWTPs, but its unique application is usually not sufficient for achieving good status where the diffuse pollution from agricultural origin is important as well. Among agricultural BMP's land use conversion of the arable land to grassland/pasture is significantly more cost effective (efficiency: 10-90€/kgP/a) than forestation (60-500€/kgP/a), however its application is rather preferable by landscape ecology and less the costs. In hilly arable lands load can be reduced by 50-80% with erosion control, cost-efficiency varies depending on the applied means (35-130€/kgP/a). Riparian buffer zones can reduce loads arriving from the direct catchment area (20-160€/kgP/a). On the other hand, widening of floodplains has positive impact on the total catchment load by increased river retention. In lowlands the most important one among measures is keeping of excess water within the area in wetlands (20-40€/kgP/a). Nutrient balances calculated from the county fertilizer statistics do not indicate such nutrient excess so that it would be realistic to suppose the further reduction of nutrient input. Therefore controlling of mineral and organic fertilizers was excluded from the evaluation of potential BMP alternatives.

### References

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