

# SEDIMENT OF AGRICULTURAL CONSTRUCTED WETLAND AS THE AMENDMENT OF SITES WITH EXCESSIVE SOLUBLE PHOSPHORUS

Johanna Laakso<sup>1</sup>, Markku Yli-Halla<sup>1</sup> and  
Risto Uusitalo<sup>2</sup>

<sup>1</sup>Environmental Soil Science  
FI-00014 University of Helsinki  
<sup>2</sup>Natural Resources Institute Finland (Luke)  
Natural Resources and Bioproduction  
FI-31600 Jokioinen  
Finland

## NOVEL USE OF DREDGED SEDIMENT

A novel use of dredged constructed wetland sediment combines the efforts towards more closed agricultural P cycles and reduced P load from the non-point source critical areas.

The erosion from Finnish agricultural cultivated area is on average 605 kg/ha/yr [1]. The suspended soil material from runoff is decreased by sedimentation into constructed wetlands and ponds (CWs, Fig. 1). Over time, plenty of soil material accumulates in the CW bottoms, which has to be dredged periodically.



Fig. 1. Liedonperä agricultural CW in south-western Finland.

## THE ERODED SOIL IS SUBJECTED TO SEVERAL PROCESSES:

- 1) selective erosion
- 2) depletion of easily soluble P by runoff water
- 3) reducing reactions in the anoxic sediment
- 4) oxidation and drying after dredging

## THESE PROCESSES RESULT IN:

- 1) mainly clay-sized sediment is rich in Fe and Al (hydr)oxides
- 2) sediment is poor of bioavailable P
- 3) Fe<sup>2+</sup> and P are mobilized from the anoxic sediment to CW water
- 4) newly formed Fe and Al (hydr)oxides (P sorption components) are effective in retaining P

## RAINFALL SIMULATION STUDY

We performed a rainfall simulation study with 2 soils of excessive soil test P concentrations. To a clay soil and a sandy loam soil were added 0, 10% and 50% wet CW sediment. The mixtures were incubated for 3 weeks, followed by rainfall simulation of 5 cm thick soil columns at 5 mm/h intensity. Runoff water was collected and analyzed for dissolved reactive P (PO<sub>4</sub>-P), total P (tot-P) and turbidity.

## SEDIMENT AMENDMENT RETAINS P FROM RUNOFF

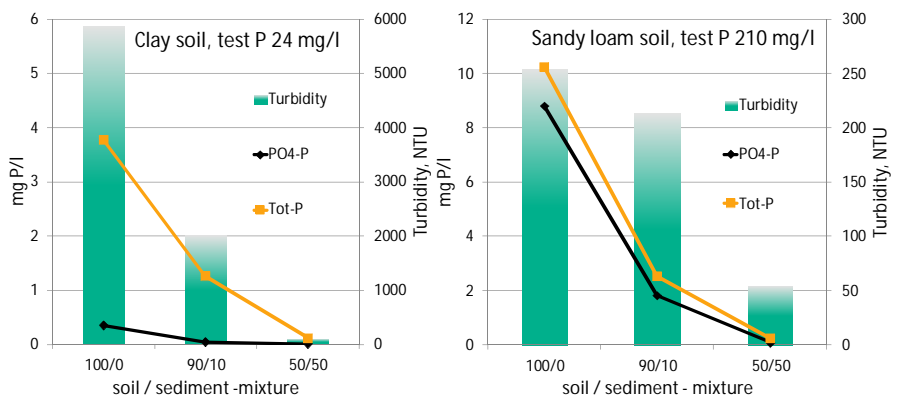


Fig. 2. Dissolved reactive PO<sub>4</sub>-P, total P and turbidity in runoff water after rainfall simulation in different soil / sediment mixtures of clay and sandy loam soils.

Already a 10% sediment amendment in the clay soil decreased PO<sub>4</sub>-P by 89% and in the sandy loam by 79% in runoff (Fig. 2). For tot-P the decrease was 67% and 75%, respectively. Also a decrease of turbidity (66% and 16%) was observed (Fig. 2 and 3).

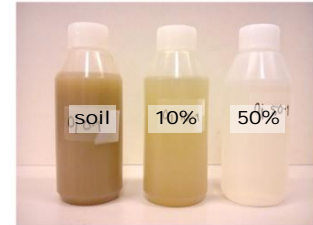


Fig. 3. Runoff water from clay soil in different sediment amendments (0%, 10%, 50%).

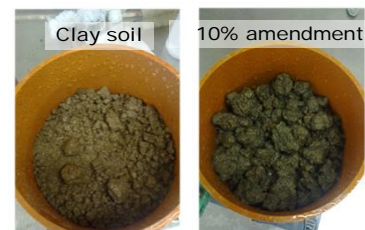


Fig. 4. Soil aggregates after 4-hour-rain. Sediment amendment increased the aggregate stability of clay soil.

- ❖ Sediment amendment increased P retention by the soils
- ❖ Soil aggregate resistance against rainfall increased remarkably
- ❖ Application e.g. for cattle feeding areas

## REFERENCE

[1] Puustinen, M., Turtola, E., Kukkonen, M., Koskiahho, J., Linjama, J., Niinioja, R. & Tattari, S. 2010. VIHMA - A tool for allocation of measures to control erosion and nutrient loading from Finnish agricultural catchments. Agriculture, Ecosystems & Environment 138, 306–317.