"LIERDAMMEN", - A WETLAND TESTFIELD IN NORWAY. RETENTION OF NUTRIENTS, PESTICIDES AND SEDIMENTS FROM AGRICULTURE RUNOFF

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ABSTRACT
Agricultural activities can lead to a loss of soil particles, nutrients and pesticides. Constructed wetlands in small arable streams can be a good supplement to best management practice (BMP) on arable fields. Previous research has shown that small CWs are capable of retaining suspended solids, particle bound nutrients and pesticides. However, the retention processes are complex, and are not fully understood. In Norway, a new experimental wetland ("Lierdammen") is built to help us understand the retention processes and to improve the next generation of small constructed wetlands. The Norwegian Centre for Soil and Environmental Research (Jordforsk) would be pleased to welcome other partners to make use of the experimental wetland "Lierdammen".

KEYWORDS: Agricultural runoff; bio-tests; nutrient reductions; pesticides; sediment-traps; wetland test-field.

INTRODUCTION
Agricultural activities can cause loss of soil particles, nutrients and pesticides. Constructed wetlands in small arable streams can be a good supplement to best management practice (BMP) on arable fields. In 2002, 100 constructed wetlands (CWs) were built in Norway. Due to the country's rugged topography, the CWs are often only 0.1 % of the watershed area.

Sediment- and nutrient reduction
Previous research has shown that small CWs are capable of retaining suspended solids and particle bound nutrients, e.g., 45-75 % soil particles (TSS), 21-44 % phosphorus (P) and 3-15 % nitrogen (N) (Braskerud, 2002). They were, however, less effective in reducing the content of dissolved P and N.

Pesticides
When pesticides are used in arable watersheds, residues are usually found in the recipients (Ludvigsen and Lode, 2001). Small CWs in first and second order streams stimulate water purification processes and can therefor reduce the loss of pesticides. A CW receiving 13 pesticides, removed between 0 and 67 % of the pesticide concentrations (Braskerud and Haarstad, 2003). In this study, the wetland covered 0.38 % of the watershed surface area, which is rather large for Norwegian standards. Possible retention factors were adsorption to soil particles and organic matter, sedimentation of particles, low or high redox-potential, and biodegradation of nitrogen-rich pesticides. However, the retention processes are complex, and are not fully understood.

METHODS
In Lier, 40 km south of Oslo in Norway, we have established an experimental wetland, to meet the requirements of efficient retention of sediments, nutrients and pesticides. The wetland is about 1200 m^2, and receives water from a 0,8 km^2 large catchment area. The catchment area includes horticulture (0,2 km^2), forest (0,15 km^2), grain cultivation (0,35 km^2) and residential area (0,1 km^2). Figure 1 is a sketch of the experimental wetland "Lierdammen".

Water enters through two pipelines from former streams together with several drainage-pipes, and flows through a sedimentation pond where coarse particles and aggregates are removed from the water phase. Water runs over V-notches, which can be regulated, and has a bypass possibility. In this way we keep the runoff natural or gravity fed (not pumped). Previous results show that erosion processes in the watershed play a significant role in the way retention process in wetlands (Braskerud, 2002). This is due to selective erosion and transportation processes and the possible impact of aggregates and flocs on the binding of nutrients and pesticides.

Experimental wetland
Water that enters the experimental wetland is distributed through a constructed vegetation filter into 8 parallel wetland compartments. Each is approximately 3 m wide and 40 m long. Each compartment has an individual V-notch in the inlet to secure the same input of water to all compartments. Compartment 4 is our control, because the average Norwegian wetland has a 0.5 m deep vegetated wetland filter. Replicate, in the statistical use of the word, is changed to the use of *semi*-replicates; e.g., organic filters contra mineral filters, deep areas contra shallow areas, vegetation contra no-vegetation etc. If needed the filter material may be replaced.

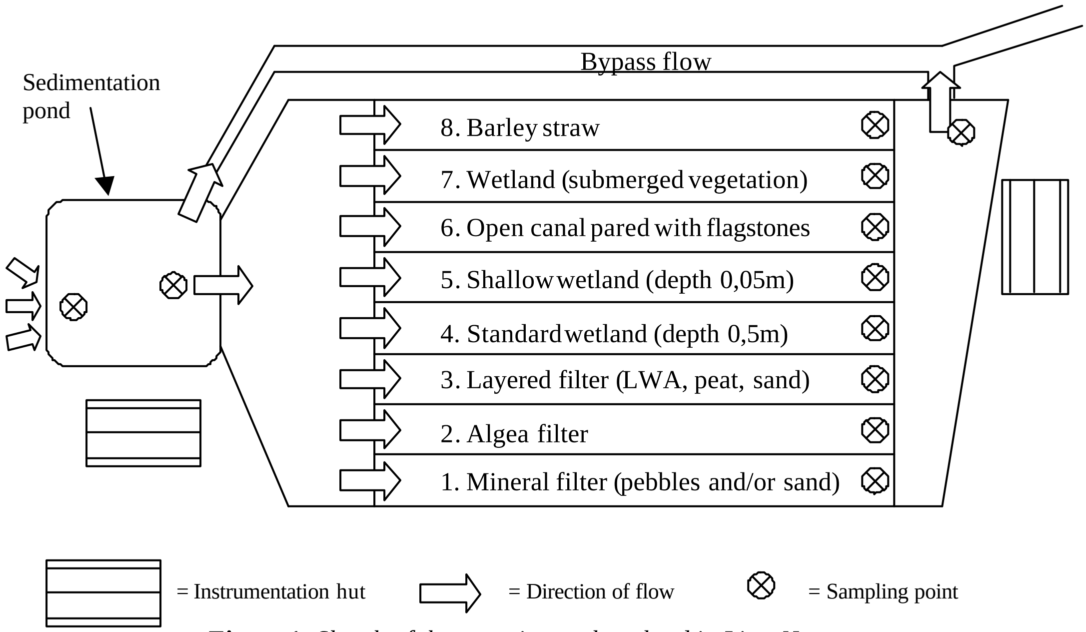

***Figure 1**. Sketch of the experimental wetland in Lier, Norway.*

Water from each compartment flows to a collecting wetland, and leaves the test wetland through a shallow dam. Figure 2 are pictures from the experimental wetland "Lierdammen" early spring- (left) and summertime (right).

***Figure 2**. Pictures from the experimental wetland "Lierdammen" early spring- (left) and summertime (right).*

Water sampling program

Water flow is monitored in V-notches in the inlet and outlet. A logger connected to a pressure gauge records the discharge, and controls a *water flow proportional sampling system* in the inlet, at the end of each wetland compartment, and on the outlet. Sub-samples (100 ml) are collected daily and pumped to a plastic sample container (pH, conductivity, TSS, N and P analyses), and through copper pipes into a copper container (pesticides). Containers are placed in fridges. A 1-liter subsample is taken from the sample container, usually in 9 to 12-day intervals, and conserved in the field. Heating cables prevent pumps and tubes from freezing and enabled sampling throughout the entire year.

RESULTS

Sampling started the late summer 2001. Wetland research requires a multi-discipline approach. As the research is in an early phase, results are limited and in preparation. However, Norwegian Centre for Soil and Environmental Research (Jordforsk) would like to invite researchers from different environmental disciplines to co-operate in order to obtain a better understanding of how constructed wetlands functions.

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