Suspended sediment dynamics in the Kromme Rijn river: Indication for intense fine sediment exchange between water column and streambed

ROB VAN DEN BOOMEN[1], HANS ZWEERS[2] & MARCEL VAN DER PERK[3]

[1]Witteveen+Bos, P.O. Box 233, 7400 AE Deventer, the Netherlands; [2]WUR-Alterra, P.O. Box 47, 6700 AA Wageningen, the Netherlands;
[3]Department of Physical Geography, Utrecht University, P.O. Box 80115, 3508 TC Utrecht, The Netherlands; e-mail: m.vanderperk@geo.uu.nl

Universiteit Utrecht

Witteveen Bos

ALTERRA WAGENINGEN UR

1. Introduction

The limited transparency of the river water of the Kromme Rijn (Fig. 1), a dammed distributary of the Rhine River in the Netherlands, restricts the ecological function of the stream and the achievement of the EU-Water Framework Directive targets. To increase water transparency in this river, the 'Hoogheemraadschap De Stichtse Rijnlanden' water authority (HDSR) considers to design one or more large-scale sediment traps.

For an optimal design of these possible sediment traps, further knowledge about the local sediment characteristics and sedimentation and resuspension rates is a prerequisite. At the request of the HDSR, we studied the fine sediment characteristics and dynamics in the Kromme Rijn river and its tributaries.

Fig. 1 Location of the sampling locations (●) in the Kromme Rijn river

2. Field sampling and laboratory analysis

In 2010 and 2011, eleven monthly water samples were collected from six monitoring locations in the 25 km long reach of the Kromme Rijn river between the inlet from the Nederrijn river and Utrecht (Fig. 1). Additional samples were collected in tributary channels. The water samples were analysed for suspended sediment concentration and the suspended sediment was analysed for loss on ignition (LOI) and particle size distribution by laser diffraction.

In addition, at these monitoring locations, small sediment traps with an 8 cm circular opening were installed at 0.7 m below the water surface to measure the gross long-term sedimentation rate (Fig. 2). These sediment traps were emptied every two months.

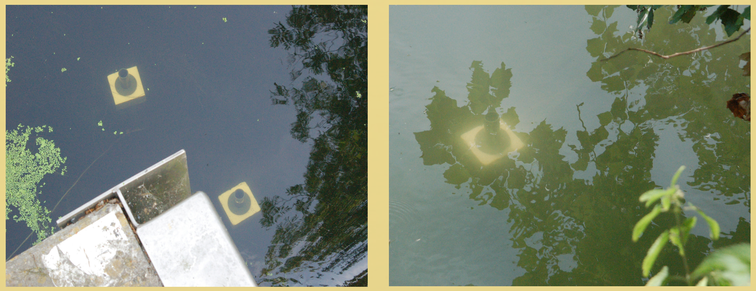

Fig. 2 Suspended sediment traps

3. Results

During the monitoring period, the average suspended sediment concentration in the Kromme Rijn near the inlet was 19 mg l^{-1} and decreased to about 12 mg l^{-1} near Utrecht (Fig. 3), but showed considerable variation in time. More than 90% of the sediment load in the main branch of the Kromme Rijn originates from the inlet from the Nederrijn river.

The 2-63 µm particle size class comprises about 80% of the suspended sediment (Fig. 3). The average LOI of the suspended sediment is 36%.

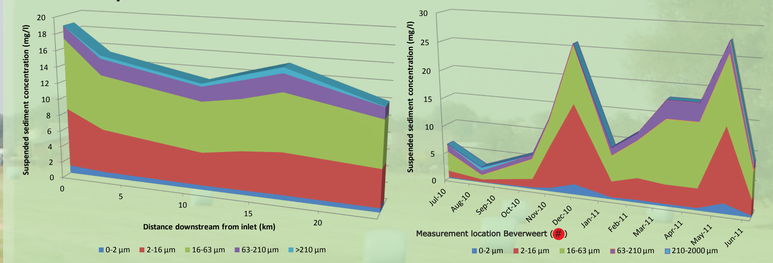

Fig. 3 Spatial and temporal variation of the suspended sediment concentration

The sediment collected from the sediment traps were slightly finer and contained less organic matter (20%). The average gross sedimentation flux in the Kromme Rijn river was measured to be 330 g m^{-2} d^{-1} (Fig. 4).

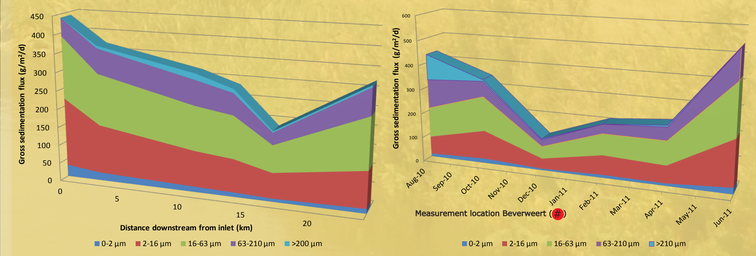

Fig. 4 Spatial and temporal variation of the gross sedimentation flux

4. Conclusions and implications

As the sediment load only decreases by 20% in the 25 km long studied reach of the Kromme Rijn river, the gross sedimentation flux should be compensated by a gross resuspension flux of approximately 240 g m^{-2} d^{-1}.

This would imply that the river reach length over which the effect of a possible sediment trap is noticeable is limited to about 5-10 km.