UFZ-Bericht Nr. 18/2004

11th Magdeburg Seminar on Waters in Central and Eastern Europe: Assessment, Protection, Management

Proceedings of the international conference
18-22 October 2004 at the UFZ

Walter Geller, Jan Blachuta, Šarka Blažková, Evelyn Claus, Alfred Dubicki, Hildegard Feldmann, Helmut Guhr, Edeltrauda Helios-Rybicka, Hubert Holzmann, Wiwiana Szalinska, Wolf von Tümpling, Gulay Záray (Eds.)

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Influence of landuse on the water quality of the Volga River – results of the Volga-Rhine research project

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The protection of surface water bodies is of central importance for the provision of drinking water in the european part of Russia. More than 2/3 of the consumed water is processed surface water. Drinking water quality is temporary reduced because of intolerable concentrations of ammonium, trihalogenemethanes (THM) and turbidity. Within the frame of a joint Russian-German research project detailed investigations about the surface water quality and nonpoint source pollution in the Volga catchment are conducted to characterise nutrient concentrations and loads. Although the heavy metal load of the Volga river is comparable low, the concentrations of phosphorus and nitrogen in the river is seasonally high and leads to distinct signs of eutrophication. Additionally, the concentration of dissolved organic carbon (DOC) is very high and reaching up to 15 mg L^{-1}. Hence, the purification and chlorination of water results in critical concentrations of THM in drinking water. An exemplary study and detailed modelling is carried out in the 20 km² Lubazhinkha catchment 100 km south of Moscow to characterise the source areas and transport pathways of major nutrients.

Table 1: Characterisation of winter conditions and erosion from plot experiments in the Lubazhinkha catchment, Russia (italics-field crop rotation, bold-soil conservation crop rotation)

Year	Water equivalent of snow [mm]	Runoff [mm]	Soil erosion [t/ha]	Frost depth before snowmelt [cm]	Date of end of snowmelt
1986	*80.6* **85.3**	*34.2* **36.3**	*0.32* **0.34**	-	31.03
1987	*44.6* **50.0**	*14.8* **15.3**	*1.12* **1.31**	*152* **132**	02.03
1988	*74.1* **79.2**	*26.8* **37.5**	*1.21* **1.32**	*95* **100**	01.04
1989	*64.6* **63.6**	*0* **0**	*0* **0**	*17* **15**	19.03
1990	*35.0* **35.5**	*0* **0**	*0* **0**	*45* **35**	17.03
1991	*42.5* **43.8**	*0* **0**	*0* **0**	*30* **30**	25.03
1992	*58.5* **67.2**	*23.1* **27.3**	*0.51* **0.52**	*40* **41**	26.03
1993	*30.1* **32.6**	*16.8* **19.6**	*2.00* **2.20**	*90* **85**	23.03

Main erosion process is rill development that occurs during snowmelt events and is strongly linked to frozen soil conditions. Results from plot experiments indicate the importance of winter grain to reduce this erosion which can achieve values up to 2 t ha^{-1} (Tab.1).

Additionally, the temporary pasture which is located on slopes near the main channel is an area of erosion. The forest is characterised by shallow and wide overland flow in depressions. The nutrient and organic matter loads are particularly high from these locations. The model system WASIM/SMEM/AGNPS is applied to characterise specific measures to reduce the nonpoint source pollution in the catchment and to evaluate future trends in land use. The results show the potential to reduce the in-field erosion but also the unsteady equilibrium of slope processes to channel erosion (Fig. 1). A growing tourism may increase the pressure on the catchment, because of vegetable production and uncovered fields during snowmelt periods.

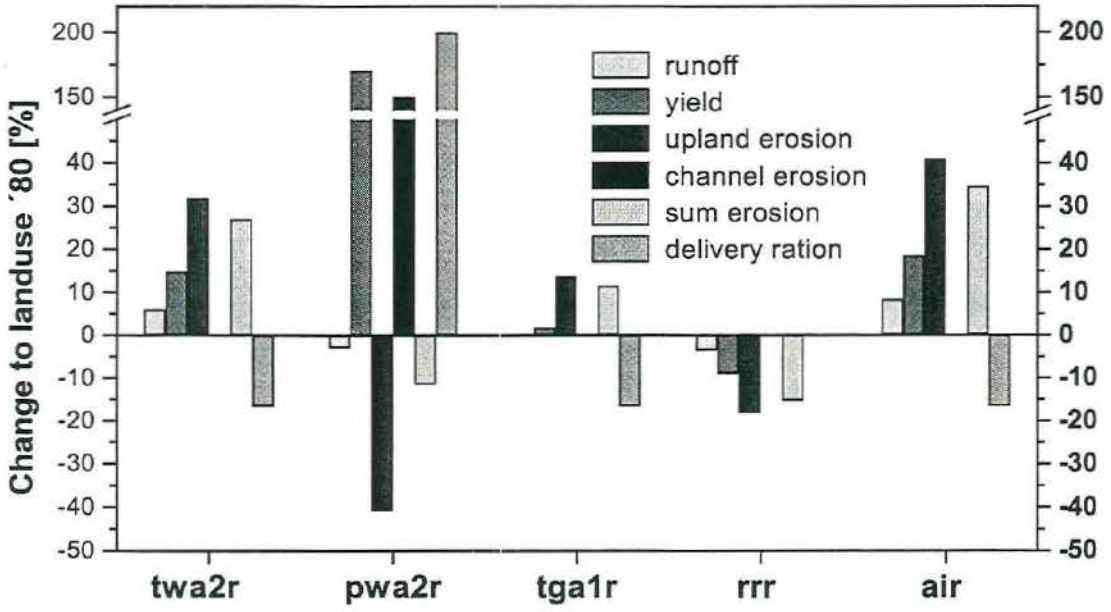

Figure : Results for different landuse scenarios for erosion and sediment delivery in the Lubazhinka catchment, Russia

The results of the project show the importance of a dual strategy to ensure the drinking water supply in the Volga catchment: *i)* improvement of drinking water treatment techniques and *ii)* better control of nonpoint nutrient sources.