Nitrate contamination of a shallow sandy aquifer in the agricultural catchment. Example of human impact on the natural environment in Western Poland

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This paper presents the preliminary results of studies conducted since summer 2011 until now, focusing on analysis of anthropogenic pressure, especially contamination of the ground- and surface waters caused by nitrogen compounds. The studied area - the catchment of the Orla River, is located in Western Poland and is a part of the Oder river basin. The catchment is 1 600 km^2 large, while the total stretch of the Orla river is 34.6 km long. For several decades the Orla catchment has been one of the most intensively cultivated agricultural areas of Poland. At present about 60% of its total area is the arable land, pastures and orchards, while the rest are mainly dwellings and woods. Thus the man-made pressure on quality of the natural environment, especially soils and waters, is apparently very high.

Geological and hydrogeological settings of the studied area are rather complicated. The northern part of the studied catchment belongs to the moraine upland, while the southern is an ice-pushed ridge. The complex of the Quaternary sediments, up to 100 m thick at maximum, is composed mostly of glacial tills with some insertions of sands and gravels. It is underlain by a thick series of Tertiary clays with some sandy and gravely lenses and layers.

The most upper aquifer is formed by the discontinuous layers of clayey sands on the moraine uplands as well as sands and gravels within the river valleys. This unconfined aquifer shows rather shallow groundwater table position, varying between 1 and 3 m, and average thickness of about 6 m. The deeper aquifers occur in the sands and gravels, only at some locations within the Quaternary glacial complex. Often those are not well isolated from the terrain surface.

The groundwater sampling sessions revealed high concentrations of nitrogen compounds in the most shallow unconfined aquifer and surface waters which are the most highly influenced by the man-made pressures. The highest nitrate concentrations, exceeding 150 $mg \cdot l^{-1}$, occur at some locations in the villages, while concentrations in groundwater for the arable land pastures are smaller – up to about 20 $mg \cdot l^{-1}$. The main causes of contamination are especially connected with the intense agricultural activi-

ties, like storage and spreading of manure and use of the artificial fertilizers. Other sources of nitrogen compounds in groundwater are the leaking septic tanks and sewage systems. The above was proved by spatial analysis of contamination which shows, for example, the highest nitrate concentration in the eastern part of the catchment corresponding to the large areas of arable land. On the other hand its western, forested part shows much lower concentrations. The analysis also shows strong dependence of surface water contamination on surface run-off. The described contamination is in effect threatening groundwater quality at the intakes of drinking water. Therefore future research will concentrate on evaluation of nitrate migration patterns and possible effect on deeper aquifers – sources of water supply.

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