IWAS International Water Research Alliance Saxony

Water quality in hydrological sensitive lowland rivers in the Western Ukraine – present deficits and future perspectives

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Motivation

- Poor surface water quality is a common problem in Central and Eastern Europe. The upper part of the Western Bug River catchment is a striking example of a transboundary river system affected by manifold, long-lasting, historical and contemporary pollution.
- Land use changes in the last decade may have led to a reduction of diffuse emissions, but deficient rehabilitation strategies for WWTPs may have increased pollution.
- Ongoing political upheavals and cost pressure impede a sustainable water resource management. A quantitative pollution regime analysis has not been accomplished yet.

Objective

The transboundary relevance, the alarming water quality conditions and the contradictive qualitative conclusions from previous studies show a clear need

i) to clarify and assess the historical and existing pollution regime,

ii) to develop methodologies for improved water resource management within the upper Western Bug River basin.

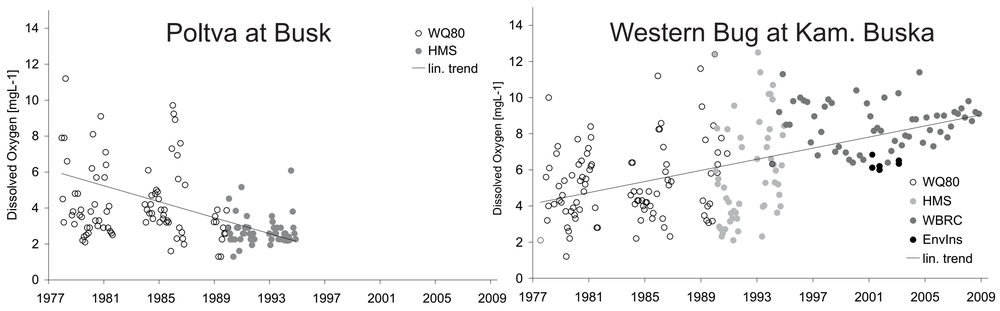


Fig. 2: dissolved oxygen (DO) concentrations recorded from different institutions over a period of 30 years (1977 - 2009). The graphs illustrate contradicting conclusions that can be drawn regarding pollution loading situation.

Methods

- Statistical analysis of historical water quality data from different institutions recorded since 1978 to identify changes in the pollution regime during the last decades.
- Field measurements in 2009 and 2010 to assess the existing water quality (incl. dynamics), main emission pathways and the self-purification potential in rivers.
- River sediment analysis regarding relevant pollutants & heavy metals, coliforms, biological indicators at selected locations.

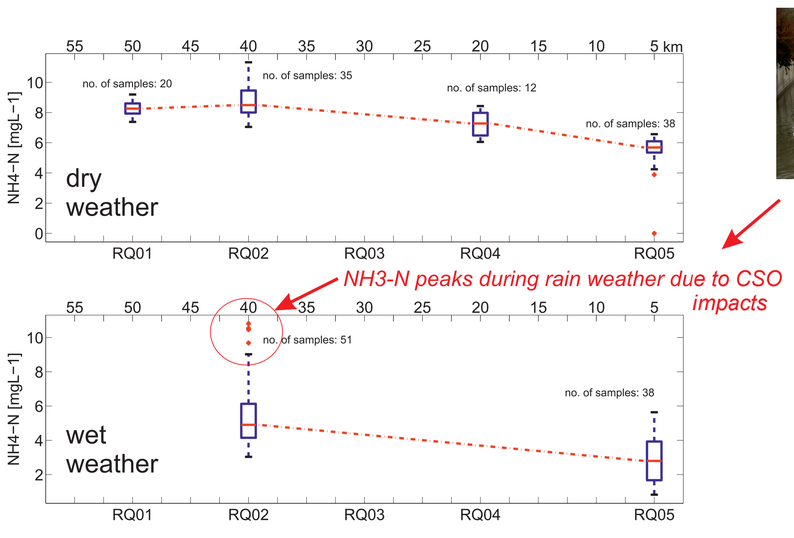


Fig. 4: longitudinal concentration profiles in the Poltva River (dry weather - upper chart; rain weather - lower chart) in 2009/2010.

Background

Fig.1: Western Bug catchment within Europe.

With a total catchment area of almost 40,000 km² the Western Bug River is the biggest tributary of the Vistula River (Poland), which ultimately drains into the Baltic Sea (see Fig. 1).

Several studies qualitatively underline that the Western Bug significantly contributes to the pollution in the Vistula River. Main deficits are described by various authors as follows:

- Niemirycz (1997): increased pollution threats Warsaws drinking water supply.
- Zaborkrytska (2006): ~15% of the Vistula pollution originates from W. Bug.
- TACIS (2001); UNECE (2007): diffuse&point sources account to this pollution.
- HELCOM (2005): Lviv system (~800,000 residents) is the 'Pollution Hot Spot'.
- Bodnarchuk (2009): loads discharged to Poltva increased from 2005 to 2007.

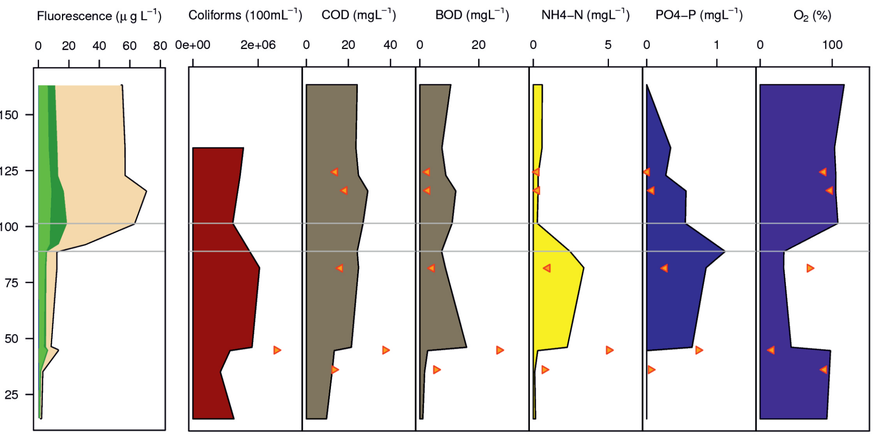
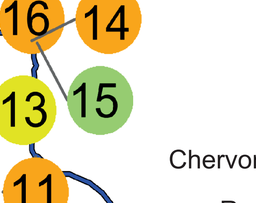


Fig. 3: longitudinal concentration profiles - Western Bug River in Sep. 2009.



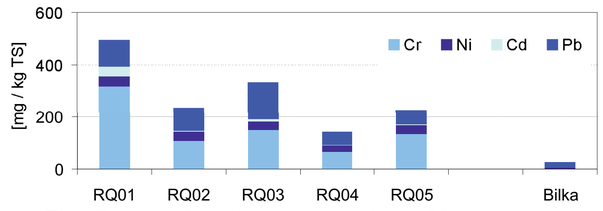


Fig. 5: cumulated concentration of heavy metals along the POLTVA and tributary BILKA (2010).

Results & Conclusions

1. Water quality in the Western Bug (at loc 6 - 9) is dominated by the heavily polluted Poltva. The *E. coli* load, estimated as fecal contamination index exceeds 230 CFU mL^{-1}, which is five times higher than upstream of the Poltva confluence.
2. The Poltva is heavily polluted by poorly treated waste-/stormwater from Lviv. NH_3-N concentrations permanently reach toxic levels; observed oxygen (DO) never exceed 2 mgL^{-1}. There is little riverine retention; jointly unfavourable conditions (low DO, toxic pollution, high turbidity) impede any self-purification.

Pollution in the upper Western Bug (upstream Busk) is comparably low.

3. The Dobrotvir reservoir improves the water quality with regard to organics, while high phosphorous concentrations and phytoplankton mass developments occur further downstream.
4. Historical data show a decreasing trend regarding nutrient concentration (e.g. NH_4-N), but an increase of organic loading and correspondingly declining DO levels (see Fig. 3).
5. Concurrent monitoring practice is constrained by cost pressure and institutional deficits. A reformation towards a more consistent monitoring would also lead to increased cost-efficiency.

ACKNOWLEDGEMENT: The results presented have been elaborated and financed within the frame of the BMBF project IWAS (Project No. 02WM1027).

Sponsored by: Bundesministerium für Bildung und Forschung

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