WATER MANAGEMENT OF THREE SLOVAKIAN-HUNGARIAN TRANSBOUNDARY GROUNDWATER BODIES

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Three transboundary groundwater bodies were investigated in the Hungarian-Slovakian border region: Ipoly Valley, Aggtelek-Slovak Karst and Bodrog within INTERREG IIIA project "Environmental state and sustainable management of Hungarian-Slovak transboundary groundwater bodies (ENWAT)" (Figure 1). Common water management plans with Programme of Measures were prepared to cover the elements defined in Annex VIII of the Water Framework Directive (WFD, 2000) and to optimally sustain water management. Also other relevant EU directives, especially the Nitrates Directive (1991) and the Groundwater Directive (GWD, 2006), EU guidelines and national legislation and guidelines related to water management, were taken into account in compilation of the groundwater management plans. The main participants of the project were the Geological Institute of Hungary and Geological Survey of Slovak Republic. SMARADG-GSH, Hungary; HYDEKO, Slovakia and GTK, Finland were subcontractors of the project. More detailed information about the project can be found on the projects website: http://www.enwat.eu.

Groundwater bodies along the Hungarian-Slovakian border form interconnected systems, which supply both countries with drinking water. Surface waters, rivers and wetland ecosystems are depending on the underlying groundwater. The national legislations, based on WFD, imply that water management on both sides of the border should aim at an adequate quantitative and chemical state of the groundwater by 2015. This calls for a common water management plans on both sides of the border which will prevent deterioration of the environmental state of groundwater. ENWAT-project was a step forward in creation of a joint Hungarian-Slovakian water management plan by supplying basic data and fresh information on transboundary groundwater bodies. Presently both countries are running their existing monitoring systems independently, the necessary exchange of information on pressures and risk assessment are shared between Hungary and Slovakia on request at regular meetings of Slovak-Hungarian Commission on Transboundary Waters. The Hungarian national groundwater quality monitoring system is operated by the regional Environmental and Water Inspectorates and partly by the Geological Institute of Hungary. In Slovakia the systematic groundwater quality monitoring is performed by the Slovak Hydrometeorological Institute.

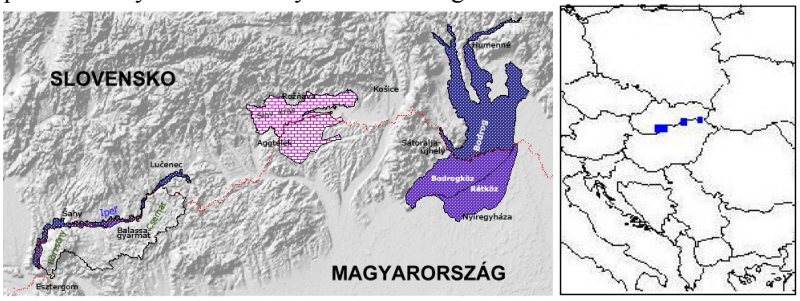

Figure 1. Location of the study areas, from left to right: Ipoly River Valley, Aggteleki-Slovakian Karst and Bodrog Region.

Water management plans were based on hydrochemical and socioeconomic data, results of the hydrogeological modeling, identification of threats, local needs and best practices. The most significant and major target group was the rural population living in these regions, using groundwater bodies as a

major drinking water supply, but also for irrigation, industrial and recreational purposes. Two different scenarios were evaluated; I: Present or increased water usage under current climatic conditions; II: Sustainable water usage considering the effects of global climate change, till 2050. The effects influencing the current water usage and the future of water production, as well as the effects influencing the chemical status of groundwater were evaluated. Concrete water management measures were presented so that the present unfavourable anthropogenic influences could be stopped and that the possible upward adverse trends could be reversed (Leveinen *et al.* 2008).

Drinking water quality problems are common in all three areas in small rural settlements, farms and single households. Most of the production wells and boreholes are shallow or have casing opening into the shallow aquifer layers (< 20 m deep), which are polluted by nitrates and other anthropogenic pollutants. In the Ipoly Valley, the water production is sustainable; however, some parts of the groundwater bodies have poor chemical status. Past use of pesticides has been intensive in Slovakia and less in Hungary, thus locally high pesticide concentrations (> 0.5 µg/l) are found in both surface water and in groundwater along the Ipoly Valley (Figure 2). In general, the pesticide concentrations detected suggest that water quality must be considered to be at risk until further investigations have been made and the additional measures as defined by WFD, have been taken. Besides mapping of the pollution and review/adjustment of environmental monitoring, investigations must aim to clarify the causes of possible failure, include review and examination of relevant permits and authorizations. A public awareness campaign on the pesticides should be organized. Nitrates have also a substantial impact on the shallow parts (0-20 m) of the groundwater system of the Ipoly Valley.

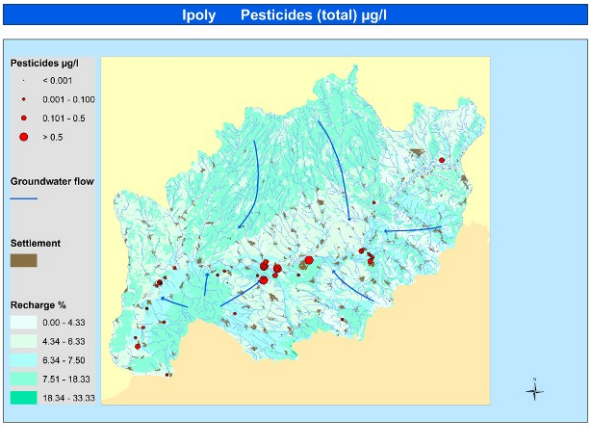

Figure 2. Ipoly River valley pesticide sampling points scaled based on the total pesticide concentration, settlements and stream network. Blue lines: regional groundwater flow directions. The background map is color-scaled based on estimated recharge distribution (Smaragd, 2008).

In Aggtelek - Slovak karst the chemical status of groundwater can be considered to be good, but the future climate change may increase the extreme hydrological events. In the worst scenario, higher and more rapid flood peaks will set pressures to water channels by erosion while drought periods damage the ecology of the fragile karst area and thus chances for ecoturism. A significant threat is the uncontrolled land use and building on flood-prone areas. Rehabilitation and creation of wetlands provides water storages and prevention of basal erosion in flow channels as well as cost-efficient measures to reduce local nitrate problems and eutrophication of surface water (e.g. by constructed wetlands). The drainage basin of Bodrog is in a state of equilibrium but the chemical status of groundwater is strongly affected by human activities (Figure 3). In Slovakia, average concentrations of NO_3 exceed 50 mg/l in 0-20 m depths. In Hungary, the data includes high NO_3 concentrations particularly in association with potential pollution sources such as rural settlements, and dump sites. Increasing evaporation due to warming climate or changes in river dynamics can increase critically concentrations of dissolved components in shallow groundwater. Due to good denitrification and biodegradation potential of organic materials, it is possible that most of the anthropogenic pollution can be attenuated so that the good qualitative status and environmental objectives in general can be attained. Due to the relatively high TDS and Cl- concentrations in shallow groundwater the future management of water resources should pay attention to the potential impacts of increasing evaporation in a warming climate.

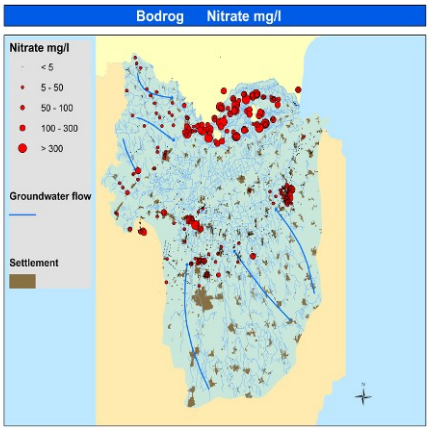

Figure 3. Nitrate concentrations in boreholes of the Bodrog-area.

The study indicated the need to continue the characterization of pollution spread and the risks for groundwater resources by more detailed sampling and modeling on both sides of the border. Co-ordination and implementation of such activities jointly could provide logistical advantages, reduce overlapping activities and lead to savings of time and money. If not a prerequisite then at least a great benefit for integrated water resources management and successful implementation of the WFD, are the direct links and co-operation between regional and even municipal authorities and expert organizations. Particularly *e.g.* in management of pollution cases and in crisis situations requiring fast response and actions, it is important that the cross-border authorities are familiar with exchanging information and communicating directly with their transboundary counterparts rather than using high-level representatives as middle-men without a good knowledge of the conditions on field.

A selected list of groundwater management actions especially for the development of water services in rural areas is presented: 1) Modernisation and updating of municipal water works, wastewater treatment and solid waste management in areas left without regional water services; 2) Training of local experts for different aspects of water services; 3) Support municipal administration outlining model contracts, guidelines for procuring services or setting Private-Public-Partnership arrangements in compliance with national legislation; 4) Establishment of water co-operatives for improving water supply of small settlements, or groups of households, farms and small companies in conjunction with the regional and local social and economical development measures, supporting improvement of the living conditions of the poor and socially excluded part of the population, particularly Roma-minority both in Slovakia and Hungary; 5) Installation of small and cost efficient wastewater and sewage treatment systems; 6) Development programs supporting the needed social integration should be initiated; 7) Assure by the further co-operation of decision makers and stakeholders in cross-border, regional and municipal level, that afore mentioned actions will be in compliance and integrated with the ongoing RBMP-process as laid out in WFD.

Groundwater directive, 2006. DIRECTIVE 2006/118/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006 on the protection of groundwater against pollution and deterioration 13 p.
Leveinen, J., Kaija, J. and Savolainen, H. 2008. Water management plans for Slovakian-Hungarian transboundary groundwater bodies: Ipoly Valley, Bodrog region and Aggteleki-Slovakian Karst. Environmental state and sustainable management of Hungarian-Slovakian transboundary groundwater bodies (ENWAT-project internal report). 86 p.
Nitrates directive: COUNCIL DIRECTIVE of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC).
Smaragd, 2008. HIDROGEOLÓGIAI MODELLEZÉS SZLOVÁK-MAGYAR HATÁRON ÁTNYÚLÓ HÁROM FELSZÍN ALATTI VÍZTESTEN, Jelentés 3.4., 3.5, 3.6, 3.11, Projekt neve Magyar-Szlovák határmenti közös felszinalatti viztestek környezetállapota és fenntartható használata (ENWAT-project internal report).

Water Framework Directive, 2000. DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy, 72 p.