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MEETING OF THE PARTIES TO  
THE PROTOCOL ON WATER AND HEALTH  
TO THE CONVENTION ON THE PROTECTION  
AND USE OF TRANSBOUNDARY  
WATERCOURSES AND INTERNATIONAL LAKES

Workshop on the protection of groundwater as a source of drinking water in karst areas

Malinska, Island Krk (Croatia), 14–15 April 2008

**REPORT**

**I. Introduction**

1. The Workshop on the protection of groundwater as a source of drinking water in karst areas, organized within the framework of the programme of work for 2007–2009 of the Protocol on Water and Health, took place on 14 and 15 April 2008 in Malinska, island Krk, in Croatia. It was jointly organized by the Croatian Ministry of Regional Development, Forestry and Water Management, the Croatian Geological Survey, Croatian Water, the Croatian Public Health Institute, and the joint UNECE and WHO/EURO secretariat of the Protocol on Water and Health, in collaboration with the United Nations Educational, Scientific and Cultural Organization (UNESCO). Also the Netherlands Ministry of Housing, Spatial Planning and the Environment financially supported the workshop organization.

**II. Objectives**

2. The workshop aimed to promote an exchange of experience on the protection, sustainable utilization and management of karst groundwater resources, including transboundary groundwaters, and addressed health-related risks for drinking water quality due to karst groundwater contamination. It also aimed to facilitate the establishment of a network of professionals working in karst groundwater management, bringing together groundwater and health managers, policymakers and technical experts and providing a platform for sharing information and experience on groundwater management, potential diseases related to drinking water, and potential pollution and deterioration of groundwater. The workshop allowed sharing lessons learned and identifying possible solutions for the better management of karstic aquifers.

**III. Participation**

3. The workshop was attended by experts from Albania, Austria, Bosnia and Herzegovina, Croatia, Georgia, Germany, Hungary, Kazakhstan, Lithuania, Romania, Slovenia, Switzerland, Tajikistan, and Turkey. Representative of the International Groundwater Resources Assessment Centre and of the Mediterranean Programme of the World Wide Fund for Nature also participated.

#### **IV. Opening of the workshop**

4. Mr. Darko Rajhenbah, Croatian Ministry of Regional Development, Forestry and Water Management, opened the workshop, welcoming the participants and recalling the framework and objectives of the workshop was organized.

5. Ms. Sonja Koeppel, UNECE Secretariat thanked the organizers and presented the provisions related to groundwater of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health as well as the related activities carried out within the Convention.

#### **V. Organization of work**

6. The workshop consisted of the following three sessions:

- Session 1: Physical, geological and hydrological conditions of karst aquifers and their implications for the protection of drinking water;
- Session 2: Monitoring the quality and quantifying and predicting impacts of water use on karst aquifers;
- Session 3: Management and protection of karst aquifers.

7. The presentations are available on the following website:

[http://www.unece.org/env/water/meetings/karst\\_groundwater\\_workshop\\_Croatia.htm](http://www.unece.org/env/water/meetings/karst_groundwater_workshop_Croatia.htm)

#### **VI. Presentations and discussion**

8. In the first session, hydrogeological features of the karst areas in different countries were presented. It was highlighted that Croatia declared a goal of providing 90% of the population with access to public drinking water supply by 2015, with sanitation systems to be improved by 60%. Croatia is currently in the middle of the process of accession to the European Union and is translating the *acquis communautaire* into national laws and by-laws, which include for example the implementation of the EU Water Framework Directive. The importance of transboundary aquifers for Croatia was highlighted by the example of the shared aquifer between Slovenia and Croatia that meets the drinking-water needs of about 400,000 people. Vulnerability risk and hazard assessment for recharge areas is being undertaken for all areas in the country.

9. The main problem of karst aquifers is the absence of surface flows to discharge waste water, the high aquifer susceptibility to accidental pollution and the extremely limited possibility of interventions. This leads to a high risk of microbial contamination of spring water in karst areas, especially if groundwater protection is inadequate and failures in drinking water treatment occur. Due to the complexity of karst systems it is difficult to identify the origin of contamination and to define the appropriate surveillance and treatment steps.

10. Regarding Croatia, it was stressed that groundwater quality is in general very good and that a substantial area of the territory is declared protection zone which can lead to landuse conflicts. However, increased turbidity and microbiological pollution during first rains after long dry periods, are problematic. In addition, availability of water during the summer, small population size, low density and inconvenient morphology as well as vulnerability of population groups such as old people and tourists represent further challenges for drinking water supply in karst areas in Croatia.

11. Main reasons of karstwater pollution in Albania as well as other countries with economies in transition include the lack of appropriate waste treatment facilities, lack of waste water treatment plants, lack of industrial water treatment plants, presence of dangerous hot spots from abandoned industrial plants, insufficient public awareness, insufficient responsibility and preparation of the administrative water bodies.

12. In several presentations the importance and difficulties of appropriate monitoring techniques for karst aquifers were highlighted. That calls for the development of specific guidelines and standardized methodologies. Geographic information system (GIS) was recognized as an important technique for vulnerability assessment. The advantages of using remote sensing including satellite imagery for vulnerability risk and hazard assessment for catchment areas were also highlighted. Land cover and land use analysis offer a good basis for assessing the key water balance parameters and dispersed pressures impacts. SINTACS is another technique for groundwater vulnerability mapping, used for example in Slovenia. Finally, the need to include temperature fluctuation in vulnerability analysis was stressed, as outside temperature can impact aquifer water quality down to -100 m

13. During the discussion after the first session, the need for enhanced methods for the definition of vulnerability zones, including nitrate vulnerable zones was highlighted. More information on specific groundwater contaminants (pesticides, organic contaminants, heavy metals), and the setting up of monitoring networks on both sides of a political border in the case of shared aquifers is often necessary. In this regard, the suitability of the SINTACS-method was discussed. However, SINTACS cannot be used for the delineation of protection zones. In addition, it was highlighted that the complexity of full scientific studies of karst aquifers should not be used as an excuse not to establish protection zones. Instead, the precautionary principle should be followed. Slovenia for example has declared the whole country as water protection zone.

14. The second session dealt with “Monitoring the quality and quantifying and predicting impacts of water use on karst aquifers”. Among others, the circumstance and implications of a flooding event in Hungary were presented. The flood took place in June 2006 and affected the health of around 10,000 people of which 4,000 needed medical care. The event occurred during the holiday period of Pentecost and started with an exceptional rainfall event of 73 mm. Water abstraction from wells was interrupted when turbidity measures exceeded the limit. When turbidity returned to normal, supply was resumed for a short while, but inhabitants fell sick and started reporting to hospital emergency rooms. Packed drinking water had to be used. Reasons for this outbreak included, among others, illegal waste dumping and wastewater discharged without treatment, the lack of contingency plans to deal with extreme weather events, the delay in sampling due to the holiday period, mistakes in judging the severity of the incident, the lack of a reservoir capacity for the municipal water supply, inadequate monitoring of the supply system, inadequate chlorination system and lack of quick testing methods for microbial contamination.

15. Croatia has had relatively little water-related outbreaks of diseases: 26 in the period 1992 – 2006 with about 1700 people affected. 15 out of the 26 outbreaks occurred in karst areas and most were related to non-community- systems or individual water supply systems. Small systems and individual household supplies are often inadequately equipped and inadequately or even not at all disinfected and filtered. Thus, the main sources of water-borne diseases in the Croatian coastal area are inadequate water disinfection and water supply directly from the source.

16. However, data on outbreaks are not reported systematically in Croatia, and non-registration remains a problem also because registration is not done at the place where the outbreaks occurs but

at the place where the medical treatment is sought. In general, the Croatian water quality monitoring system was considered as insufficient by some presenters.

17. There are over 1000 islands in Croatia, 66 of them inhabited. Drinking water supply on these represents a significant challenge, especially on small and distant islands, since clean surface water is usually lacking and the high number of tourists leads to an increase of the demand for water. Out of all inhabited islands, only 9 have their own water resources and available water is often brackish. Although many islands use water supply from the mainland through pipes or rainwater harvesting as well as private wells for their water supply, only 25% consider that they have solved the water supply problem. Therefore, presenters proposed to improve water supply on the Croatian islands through permanent desalination plants or temporary transportable plants which can be moved by trucks as well as rainwater harvesting- depending on the size of the island and on the distance from the mainland. However, water quality is often insufficient on the islands. The Ministry of Health undertook a review of drinking-water quality on all Croatian islands, which however only considered physico-chemical parameters, and did not include microbiological parameters

18. The session also included one interesting presentation on efforts to involve school children in water safety plans through hands-on experiments related to water supply, assessment of karst water vulnerability, and the performance of basic chemical and microbiological analysis. The CD *Don't bug me – pathogens and pathways of drinking-water supplies* prepared by the New Zealand Ministry of Health on small scale drinking-water distribution systems will be translated and distributed in all Croatian schools in 2008. Residents' education is very important in karst areas, especially in developing countries and those with economies in transition since, for example in Croatia, sinkholes are often used in rural karstic areas to dump trash and even household hazardous wastes; and citizens drink from unprotected and not disinfected sources. It was highlighted that residents should understand that dumping, certain land use activities as well as unprotected and inadequately maintained sewage tanks can have significant consequences in nearby and seemingly distant locations.

19. Finally, during a presentation on the survival of viruses in karstic fractured rock environment, the importance of viral pathogens and their pathways in karstic rocks was stressed, and the presenter called for the recognition of viruses (particularly Norwalk-line viruses) as specific health hazards in karst areas requiring specific measures in the protection zone. They cause several hundred deaths annually in the United States and some of them are even resistant to chlorination.

20. The final session, "Management and protection of karst aquifers", dealt with the new WHO approach of water safety plans which will be incorporated into the EU drinking water legislation, and national approaches to protect recharge areas for drinking water. The new WHO framework for safe drinking water encompasses health-based targets based on evaluation of health concerns, water safety plans that include system assessment, operational monitoring and management plans as well as a system of independent surveillance. This requires public education and training of water suppliers. The needs for further research and guidance in the existing WHO drinking water guidelines, especially related to karst aquifers and the significant expected impacts of climate change such as decrease in precipitation and increased saline intrusion were highlighted.

21. In Slovenia, rules for protection zones were reformed in 2004 and protection zones are now legalized at the state level. The three types of protection zones impose different restrictions on the use of fertilizers, plant protection products and construction of buildings and other facilities as well as wastewater discharge and treatment. In Croatia, decisions on the 6 types of protection zones are made by county assemblies.

22. The Swiss regulations with regard to protection of karstic aquifers include provisions for both prevention and treatment of pollution; i.e. groundwater protection through protection zones, groundwater management, i.e. surveillance of water quality and drinking water treatment. The drinking water treatment is adapted to the aquifer type. These key elements resemble to the systems of many other countries.

23. In contrast, Bavaria in Germany has a policy requiring that groundwater should be clean enough to be used without further treatment; therefore, the “decontamination” of treated wastewater takes place before the reinfiltration of the effluent in aquifer recharge zones. For example, sinkholes are mapped, classified and decontaminated, if necessary. Significant parts of the territory are declared as protection zones requiring different levels of protection. Like in other countries the Bavarian procedure for declaring a protection zone involves the publication of the plans by the administration, a period where affected persons can hand in objections, public hearings and finally the publication of the decision. This procedure is used in order to increase public acceptance and thus compliance. Special modelling methods such as the PI method (evaluation of protective function and consideration of fast runoff components) are used for vulnerability mapping as a basis for the protection measures taken<sup>1</sup>. Particular efforts are being undertaken to protect karst aquifers in Bavaria from pollutants resulting from accidental pollution on motorways, such as sealing of lane basis by bituminous subbase and sealing of dewatering pipes and manholes. In addition, two kinds of basins are constructed at the side of the motorway: retention basin to take up contamination and restriction basin to allow continuous infiltration. Such measures can add between 10 and 15% to the cost of motorways construction. All dewatering plans and plans of protection zones are handed over to fire brigades and the police for emergency cases. Finally, special awareness raising campaigns are used to inform the population.

24. At the end of the workshop it was stressed that 25% of the world’s population depends on karst aquifers for their daily drinking-water supply<sup>2</sup>. The importance of information management, awareness, motivation, institutional frameworks and operation means for transboundary aquifer management and drinking water protection were underlined.

## **VII. Closing of the workshop**

25. At the end, Mr. Darko Rajhenbah and Ms. Sonja Koepfel thanked the speakers for their interesting presentations and the participants for their valuable inputs to the workshop discussion. They noted that the workshop contributed to the exchange of experience and good practice on national and international developments regarding the protection of groundwater as a source of drinking water in karst areas.

## **VIII. Field trip**

26. On the afternoon of Tuesday, 15 April a field trip was organized to visit the towns of Baška and Vrbnik on Island Krk. The programme included a visit to a landfill and its water protection facilities.

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<sup>1</sup> Article in Grundwasser Vol. 8(2) 2003

<sup>2</sup> Ref. [www.isarm.net](http://www.isarm.net)