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Meeting Report

IMPEL mini-conference "Trend reversal in groundwater pollution"

4 September 2023 in Frankfurt a.M.

Time: 9 a.m. – 4 p.m. CET

Location: *Behördenzentrum Gutleut*, Frankfurt am Main, Gutleutstraße 130, Room U 1.50

Participants:

1. *Thomas Ormond* (Regierungspräsidium [RP] Darmstadt = Regional authority of South Hessen / Higher Water Authority in Frankfurt, DE; Meeting Chair)
2. *Tim Besien* (Environment Agency, UK)
3. *Astrid Bischoff* (HMUKLV = Hessian Ministry of the Environment, DE)
4. *Iustina Boaja Popescu* (Geological Institute of Romania)
5. *Julien Brogard* (SGD Nord = Water Administration Koblenz, DE)
6. *Lehel Ákos Csobaji* (Ministry of Interior, Department of River Basin Management and Water Protection, HU)
7. *Arta Dollani* (National Environmental Agency, AL)
8. *Ute Göttlicher* (HMUKLV = Hessian Ministry of the Environment, DE)
9. *Judith Grimm* (Hessenwasser)
10. *Birgitte Hansen* (Geological Survey of Denmark and Greenland, DK)
11. *Anja Hillmann-Stadtfeld* (SGD Nord = Water Administration Koblenz, DE)
12. *Franziska Kroll* (RP Darmstadt / Higher Water Authority in Frankfurt, DE)
13. *Johanna Kunze* (RP Darmstadt, trainee, DE)
14. *Moritz Leps* (RP Gießen / Higher Water Authority, DE)
15. *Katharina Meyer* (FiBL = Research Institut of Organic Agriculture, DE)
16. *Nadine Palleria* (FiBL = Research Institut of Organic Agriculture, DE)
17. *Matthias Peter* (Schnittstelle Boden, DE)
18. *Neritan Postoli* (National Environmental Agency, AL)
19. *Jola Proko* (National Environmental Agency, AL)
20. *Arno Quadflieg* (formerly HMUKLV, DE)
21. *Annabill Rasp* (RP Darmstadt / Higher Water Authority in Wiesbaden, DE)
22. *Johanna Rathmann* (RP Darmstadt, Higher Water Authority in Frankfurt, DE)
23. *Susie Roy* (WSP, UK)

- 24. *Sebastian Schrader* (RP Darmstadt / Higher Water Authority in Frankfurt, DE)
- 25. *Claudia Stößel* (Lower Water Authority Wetteraukreis, DE)
- 26. *Claude Thielen* (Administration de la gestion de l'eau, LU)
- 27. *Anke Uhl* (RP Darmstadt / Higher Water Authority in Darmstadt, DE)
- 28. *Szonja Viktoria Ujvarosi* (RP Darmstadt, trainee, DE)
- 29. *Pascal Wunderlich (Scheffler)* (Wasserverband Kinzig, DE)

Agenda and key results of the mini-conference:

1. Welcome / Introduction

Thomas Ormond as project manager welcomed everybody and started the conference with an introductory presentation about the background to IMPEL, the project at hand and other ongoing IMPEL water projects. There are widespread problems with groundwater pollution and mostly increasing trends across Europe. The main pollutant is nitrate from agricultural overfertilisation. According to a report by the European Environment Agency, published in 2018, the total groundwater body area with an identified upward trend (9.9 % of area) is nearly double with a trend reversal (5.9 %) and this is mainly due to nitrate. So more measures are needed to reverse this negative trend. The IMPEL project wants to contribute by collecting good practice examples and giving recommendations from a practical viewpoint. The next step is to finalise the "Trend reversal" guideline with conclusions and recommendations based on such practice examples, as well as a survey report summarizing the 17 replies from 12 member countries to a questionnaire about the national/regional trends of groundwater pollution and examples of trend reversal. The reports and the guideline are to be submitted to the IMPEL General Assembly for adoption at its session in late November 2023, and it is envisaged to translate the guideline into German and possibly other languages in early 2024.

2. Reversing nitrate trends in groundwater since the 1980s – the Danish example

The following presentation by *Birgitte Hansen* of the Geological Survey of Denmark and Greenland focused on the Danish approach of the mitigation of groundwater pollution with a special emphasis on the nitrate pollution caused by agriculture. Historically, the increasing import of synthetic fertilizers and feed from the 1940s until 1975 caused an increasing leaching of nitrate into the groundwater during these years. A growing public environmental awareness forced the Danish government to adopt a National Action Plan and mitigation measures since 1985, including tools like maximum animal stock density, better handling and utilization of nitrogen in manure, maximum N-quota for specific crops, and recently the use of catch crops. Since 2016 Denmark has focused on developing more geographically targeted mitigation measures as a supplement to the general regulations. A clear effect of the national nitrogen regulation is seen until 2000 after the trend reversal of nitrate in oxic Danish groundwater from the mid-1980s. On the other hand, *Birgitte* explained that due to requirements for improving the economic conditions farmers were allowed to use more fertilizer from 2016, a modification which tended to cause an increase in nitrate pollution of oxic groundwater. In Denmark all drinking water originates from groundwater, and nitrate is not being removed by treatment at the waterworks. At the end of her presentation, *Birgitte* showed results from a large epidemiological Danish study on the health effects regarding

colorectal cancer on nitrate in drinking water. The study found a 15 % higher risk of colorectal cancer when comparing the 1/5 parts of the population having the lowest concentrations (< 1.27 mg/l) to the 1/5 parts of the Danish population having the highest concentrations (≥ 9.25) of nitrate in drinking water at public waterworks.

3. Trend reversal of nitrate pollution in Hessen from the perspective of water authorities

In the following presentation, *Astrid Bischoff* of the Hessian Ministry of the Environment gave an overview on nitrate pollution problems in the German state of Hessen and the measures taken to meet the good status objectives and reverse pollution trends. In Hessen, 29 out of 127 groundwater bodies exhibit a poor chemical status due to nitrate pollution. Furthermore, at 693 of 4070 groundwater monitoring sites (17 %) the nitrate concentration exceeds 25 mg / l. The proportion of groundwater monitoring sites with a falling trend (23 %) is well above that with rising trend (13 %) while the majority (64 %) of groundwater monitoring sites show no significant changes in nitrate concentrations since the year 2000. In addition to the legally binding regulations, the government aims to achieve trend reversal within catchment areas of abstraction points of water intended for human consumption by promoting voluntary cooperation agreements between water suppliers and local farmers within water protection zones. The agreements comprise intensive water protection oriented agricultural consultancy, compensation payments for economic losses for farmers and sanctions in the case of non-compliance. Especially in some zones with long-standing cooperation agreements and intensively advised farms, a downward trend in nitrate pollution could be observed. With these instruments and other measures under the freshly amended Fertiliser Ordinance (DüV), the Water Framework Directive as well as the Future Water Plan Hessen, adopted in 2022, the Hessian government aims to achieve a good chemical status of groundwater bodies in the long term.

4. Trends in groundwater pollution and necessary measures from the perspective of a water supplier

In the next presentation *Judith Grimm* of Hessenwasser described the trends in groundwater pollution and necessary measures from the perspective of Hessen's biggest water supplier. The Hessenwasser GmbH & Co.KG is a public-owned water company based in Groß-Gerau, south-west of Frankfurt am Main. The company's main task is to provide drinking water for the cities of Frankfurt, Wiesbaden and Darmstadt and about 50 other municipalities and associations in the Rhine-Main region. In her presentation, *Judith* stressed the importance of cooperation with local farmers, but also of intensive consulting and active support by the authorities. Unfortunately, many "water protection zone" regulations are not up-to-date and partly abrogated by voluntary cooperation agreements which are dependent on the goodwill of farmers. *Judith* pointed out that in most cases the cooperation works well but that there are always some "black sheep", i.e. farmers who are not willing to participate and cooperate, and that a proper surveillance of these farms by the authorities is lacking. Also she observed a general uncertainty about which rules apply in certain areas, the "WFD action area" rules or the "red area" under DüV regulations. *Judith* saw a clear need for action, especially concerning a more transparent demarcation of nitrate polluted areas and an improved cooperation between the water suppliers and public authorities. Furthermore, a better system of support

measures for local farmers would be needed, including intensive advice and financial support of organic farming. *Judith* advocated a stricter implementation of the "polluter-pays-principle" on the one hand, and a compensation of "locational disadvantages" for farmers on the other.

5. Practical experiences in cooperation with farmers

The following presentation was given by *Matthias Peter* of the consulting company *Schnittstelle Boden* whose main fields of work are water protection, soil protection and the moderation of participation processes. According to *Matthias*, the main sources of nitrate pollution are farming, infiltration, a leaky canalization, bog holes, cesspits, and disposal sites. Since 1990 several amendments to the German Fertiliser Ordinance have achieved little results for groundwater protection. One major problem in Germany, as he sees it, is the enforcement deficit in monitoring the implementation of the relevant legal requirements. In his opinion it is unavoidable and necessary to improve the cooperation between public authorities, local farmers and private water suppliers and other players. Furthermore, he pointed out a lack in agricultural education concerning environmental goods (soil, water, air) and proposed the setting-up of such specialized classes in the educational training of young farmers, in order to create an awareness of pollution problems and their solution. *Matthias* went on to present some examples for positive effects on water protection by the Fertiliser Ordinance 2017/2020, such as the restriction of autumn fertilization with organic material which led to a reduction of nitrogen and ammonium input. On the other hand, he named some of the negative effects, mainly that the field-specific upper limit of N-fertilisation is still significantly above the actual nitrate requirement of the cultivated crops and that organic fertilizer applied to the previous crops is only credited with 10 % of its total nitrate. He concluded by again stressing the importance of cooperation as a step in the right direction and the need for further action to bring down nitrate levels in groundwater.

6. The influence of soil texture on Nitrates leachability - 3 Romanian examples

Iustina Popescu Boaja of the Geological Institute of Romania described the situation in her country, and especially South Romania as one of its most important cereal production areas. She stated that the intensive exploitation during the communist period (until 1989) is mainly responsible for the precarious quality of groundwater. In order to ensure the implementation of the EU Nitrate Directive, the Romanian Government started the "Integrated Control of Nutrient Pollution" project to reduce pollution from agricultural sources. Furthermore, in 2023, the government signed a 20 million Euro loan agreement with the World Bank for the "Prevention and reduction of pollution in rural areas" project which focuses on nitrates, ammonia, pesticides and antibiotics. These objectives should be reached by strengthening the institutional capacity of selected public entities to monitor agricultural pollution and by the dissemination of knowledge to farmers regarding the reduction of agricultural. *Iustina* emphasized the importance of proper soil management, e.g. a soil management plan which should be updated after several years (depending on the pressures that occur in the respective area). From a series of chemical experiments she conducted, *Iustina* concluded that different soils have different nitrate leaching vulnerability depending on the soil texture. From this follows that nitrate leachability is a very fast process which depends in a large proportion on soil moisture, texture and microbial activity. These conditions have to be considered in a proper soil management.

7. A brief history of reversing upward trends in groundwater nitrate pollution in England

Tim Besien from the Environmental Agency (England, UK) and *Susie Roy* from the consulting firm WSP split their presentation into two parts.

In the first part, *Tim* gave an overview of the different measures that were taken to reverse the upward trend in groundwater pollution in England. From 1990 to 2003 the Nitrate Sensitive Areas (NSA) Scheme was applicable in England, as a voluntary, compensated measure which aimed to reduce nitrate leaching from agricultural land to vulnerable groundwater by modifying land use management. Even though the NSA Scheme has had a measurable beneficial impact on nitrate leaching from the soil zone, the long timescales often associated with groundwater responses mean that, in many areas, the impact of relatively short-term agricultural control schemes such as NSAs will not be realized for several decades. Since 1996 Nitrate Vulnerable Zones replace the NSAs. Unfortunately, the newly implemented schemes are statutory, but farmers are no longer compensated which led to only a minimal reduction in nitrate concentration since 1996. In 2018 a new policy paper was published by the British Department for Environment, Food and Rural Affairs called "Farming rules for water – getting full value from fertilisers and soil". In *Tim's* opinion, among the several types of approaches that have been used in England to reduce nitrate concentrations in groundwater, the most effective schemes have been those that paid farmers to make land management changes (payments for ecosystems services). He concluded that statutory schemes generally have limited effectiveness, mainly because the measures were not robust enough or the schemes were stopped prematurely.

Susie Roy of WSP followed with a presentation on "Nitrate trends in the Chalk of South East England". She described two regional projects, "Defusing the Nitrate Time Bomb – Review of nitrate trends in the Chalk" and "Karst feature mapping to support water catchment advisors", which aim at the use of regional groundwater resources models to predict nitrate trends and model scenarios. The idea is to get a better understanding of temporal and spatial trends and controls. Concluding her regional nitrate trend review, she saw a general upward trend with an apparent recent stabilization. As winter peaks will still exceed the drinking water standards, one might consider a reduction through managing faster flow paths. For this, a more intensive karst mapping is essential.

8. Follow-up to "Trend reversal" with an IMPEL nitrate project

In a short statement before the final discussion, *Annabill Rasp* of the regional authority in South Hessen outlined a follow-up project to "Trend reversal" which should officially start in 2025 and focus on nitrate pollution of groundwater and possible counter-measures. The project would be led by her and *Michael Zacharias* from the Hessian State Agency for Nature Conservation, Environment and Geology (HLNUG) and would offer the chance to look more in depth at measures in Germany as well as other European states to reduce nitrate input, such as the Danish fertilizer register, the limitation of fertilisation through nitrogen quotas or awareness-raising regional projects like the marketing of "water protection bread" in Bavaria where wheat grown in water conservation areas and used for bread production is fertilized less than usual. The objective of the project is to analyse the effect of various measures, taking into account specific conditions such as cultivation structure, drought or dryness and

resources used, so that a variety of adapted measures could be offered to other countries with similar conditions. *Annabill* invited the participants of the IMPEL conference to join her in this new project.

9. Final discussion

Answering a first question in the final discussion, *Birgitte Hansen* confirmed again the connection between high nitrate concentration in drinking water and the higher risk of colorectal cancer for the consumer, as found in a large Danish epidemiological study.¹ The results of the study provide evidence, together with results from other studies, for reconsidering the drinking water standard for nitrate. This standard, however, has so far not been changed.

Furthermore, in relation to *Matthias Peter's* presentation, the environmental awareness or rather lack of it among young farmers was discussed. *Matthias* pointed out that in his opinion the implementation of environmental rules especially concerning the protection of soil, water and air in the vocational training of farmers is absolutely crucial for creating consciousness and a sense of responsibility.

Finally, *Tim Besien* responded to a question about the importance of economic incentives and the reaction to rule violations. Referring to his presentation, *Tim* emphasized that schemes which give farmers an incentive to change the way how they process their fields are most efficient but should go hand in hand with schemes that focus on the enforcement of statutory rules and the punishment of violations. Fines should be high enough to have a real deterrent effect so as not to be treated as calculated costs of business by farmers.

10. End of mini-conference

Thomas thanked the presenters and participants and closed the workshop at 4 p.m. CET.

Drafted: Johanna Kunze / Thomas Ormond, 16 September / 6 October 2023

¹ Schullehner, J.; Hansen, B.; Thygesen, M.; Pedersen, C. B.; Sigsgaard, T., 2018. Nitrate in Drinking Water and Colorectal Cancer Risk: A Nationwide Population-Based Cohort Study. *Int. J. Cancer* 2018, 143 (1), 73–79. <https://doi.org/10.1002/ijc.31306>.