Nitrate: a serious problem for German groundwater

Introduction

Water is the most important resource; clean water is essential for survival both long and short term. This importance is also reflected in the fact that access to clean water is one of the 17 UN development goals. Goal 6.1 reads: "By 2030, achieve universal and equitable access to safe and affordable drinking water for all"[2]. 99.99% of this goal has been achieved in Germany. But the goal 6.3, "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion ..."[2], is far from being achieved. In Germany we have a lot of good water available compared to other regions. As a result, we still pollute important water resources despite our better knowledge, making it useless for drinking water production [1].

Current situation in Germany

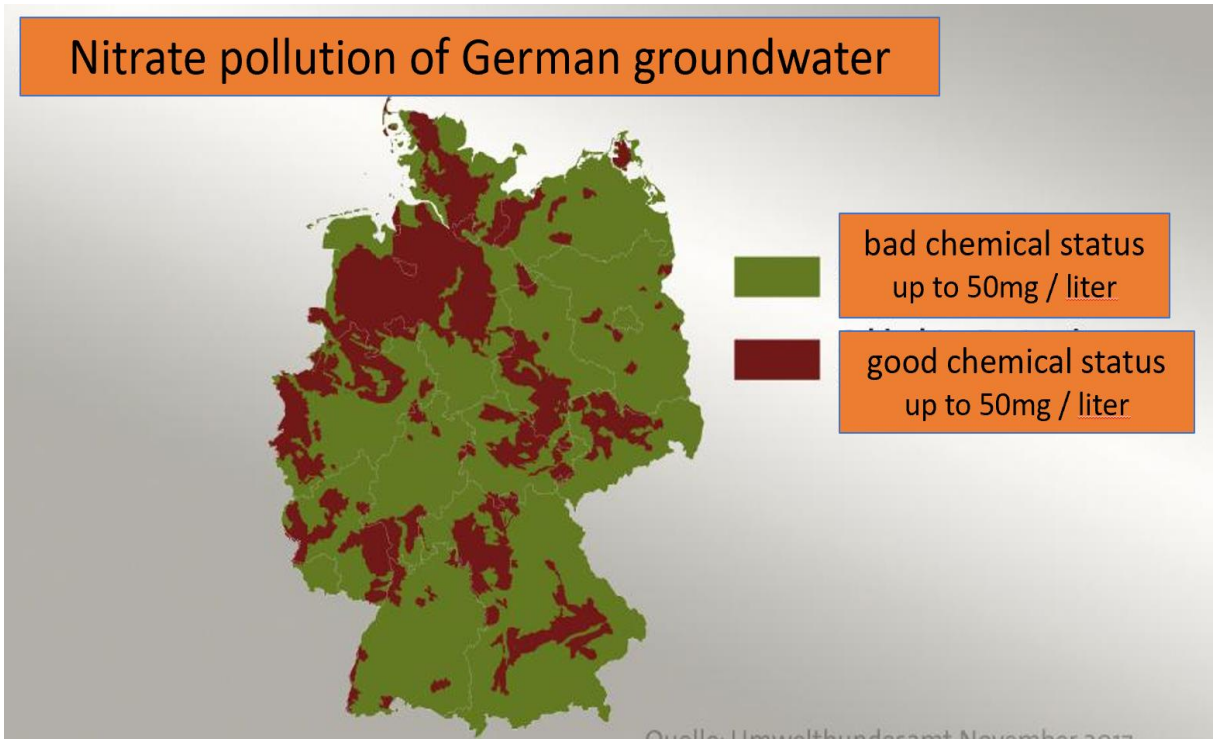

Figure 1 current nitrate pollution situation in Germany source edited

In Germany, 70% of drinking water is obtained from groundwater [3]. In the north of Germany this proportion is even higher [4] and yet Germany still does not manage to comply with the nitrate requirements of the European Union. The nitrate concentration in North German groundwaters is so high that some drinking water wells can no longer be used, and the European Union is suing Germany [5]. The European Nitrate Directive obliges Germany to prevent the limit value for nitrate of 50 milligrams per liter groundwater from being exceeded.

Since 2008, the limit value has been exceeded at almost every fifth groundwater measuring point every year [6]. Nitrate can be converted into nitrosamines in the human body. In infants, this can lead to a disturbance in oxygen transport (methaemoglobinaemia). In addition, the presence of nitrate-contaminated drinking water significantly increases the risk of colon cancer [7].

Pathways of nitrate into the groundwater body

Nitrate (NO3-) is very soluble in water, so there are hardly any larger deposits in soils. Therefore, the nitrate which gets into the soil will reach the groundwater body in the long run. There are two main routes for the input of nitrate. Nitrate can be carried in the Soil by microorganisms from the atmosphere. This is relatively slow process, so that the annually entry is small. The other natural way is through excreta of living beings.

For man-made nitrate entry into the water cycle, two main entry routes can be identified. Nitrate is spread by sewage treatment plants in rivers and by fertilization on fields.

Nitrate is a natural component of our urine and excrements. A high load of nitrate is transported through the wastewater to our treatment plants. In the treatment plant, over 70% of the Nitrate in the wastewater is converted into elemental nitrogen. This elemental nitrogen is released from the sewage plant into the atmosphere. This process is completely harmless, almost 80% of the atmosphere consists of nitrogen. Only large quantities of Nitrate are let into the water circuit in case of extreme weather conditions or leakage.

A significantly higher input of nitrate into the groundwater occurs through diffuse sources. The main cause of this is agriculture.

In agriculture, crops are supplied with the required nitrogen by fertilizers. Nitrate is often the limiting factor for plant growth alongside phosphate. However, fertilizers are often not applied in a manner appropriate to the location and use. If the amount of fertiliser is too high, plants do not absorb the nitrogen completely. The excess nitrogen is leached out and reaches the groundwater and other waters as nitrate. In rivers and lakes this leads to overfertilization, in groundwater to nitrogen accumulation and exceeding the nitrate limit.

The fertilizer used in agriculture is usually liquid manure. Especially the autumn/winter months are problematic. During this period, a lot of liquid manure is still produced due to intensive livestock breeding, but there is no need for fertiliser during this period due to the vegetation phase. A small part of the liquid manure can be stored in silos, but most of it must be applied to the fields. This part is then washed out of the upper soil layers in the many rains typical for these months. In this way, the nitrate reaches deeper soil layers and finally the groundwater.

Consequences of nitrate pollution

First, the quality of the drinking water deteriorates, since the raw quality is decisive for the final product. A simple consequence of nitrate pollution is that the aquifers near the surface can no longer be used as drinking water sources. The water can be purified to drinking water but with a much higher effort, which would mean a high input of money and energy. Therefore, existing wells usually must be rebuilt or even newly built. In doing so, occasional

deeper aquifers are tapped. However, this is not a solution to the problem. The nitrate-polluted soil water also reaches deeper aquifers, but it does so with a huge time delay. The natural nitrate decomposition only occurs in layers close to the ground, so that in deeper ground there is no question of a higher purification performance. The nitrate load is only buffered by the upper layers.

In addition to the consequences described above, excessive nitrate input also has a devastating effect on flora and fauna. Almost half of all ecosystems in Germany are now affected by eutrophication and acidification. Due to the nitrogen introduced, the mostly nitrogen-poor ecosystems in Germany are over-fertilized. Their original plant species are being displaced by the nitrogen-loving species, the composition of plant communities is becoming unbalanced and, as a result, species diversity is declining. More than 70 percent of the plant species listed in the Red List in Germany are species of nutrient-poor locations.

What Germany is doing to combat nitrate pollution

As early as 2006, the EU urged Germany to do something about the increased nitrate measurements. For a long time, nothing happened until the fertilizer ordinance was finally passed in 2008. This law regulates the entry of manure on agricultural land. However, this law was far too weak for the European Union and therefore sued Germany on the grounds that this draft law did not go far enough. The European Union won the lawsuit in 2018 before the European Court of Justice and forced Germany to act more aggressively. Therefore, a stricter fertilizer law is to be passed and come into force in 2020. The new law provides for a stricter calculation of the permissible amount of fertilizer, a more specific calculation (specific per area and not per plot), stricter guidelines for the fertilization of catch crops and seasonal yield bans. [9]. Financial support for more efficient methods of spreading liquid manure is also to be decided by the new law.

Why is no more done

The difficulty with groundwater protection is that groundwater protection is expensive, time-consuming and not visible to the public. Groundwater protection is expensive because, on the one hand, it is extremely time-consuming to examine the aquifer and, on the other hand, because farmers lose revenue at least in the short term. The effort is also extremely high because there are many stakeholders with many different interests. The visibility of the effectiveness of the groundwater management measures is virtually non-existent for the population. So that the population only meets the topic of groundwater if there are problems.

Another aspect is that the agricultural lobby is very strongly anchored in German politics. More than 50% of the German land is used for agricultural -economic purposes [10]. Therefore, this branch of industry has enormous political power and emotionalizes and drags out the discussion about groundwater protection. The assurance of financial support should counteract this.

What could be done additionally

These steps do not go far enough for leading nature conservation and water boards and therefore they demand further steps. They call for area-based livestock farming, so that the number of livestock kept must be adapted to the area available. Additionally, agricultural subsidies should be redirected in such a way that organic farming is rewarded significantly more than traditional farming. Furthermore, in order to protect water bodies from over-fertilisation, distances of ten metres from the water's edge should be maintained. This is already being implemented by some federal states. This is because the five metres required by law do not offer enough protection against the leaching of nutrients. Finally, a change in the maximum permissible fertilization is demanded. Thus, the maximum fertilization amount should be adapted to the needs of the cultivated plants as well as to the soil conditions. [11]

Summary

The German nitrate problem is still unsolved today. It will remain definitive if the new legislation does not come into force in early 2020. I personally believe, however, that this can only be the beginning. On the one hand, some of the measures demanded by the nature conservation organisations still must be implemented (especially stronger promotion of organic farming methods), on the other hand, a rethink is needed in Germany.

Germany is one of the leading industrial nations and yet the meat here is cheaper than anywhere else. The Germans must begin to value food more. They should start to put quality over quantity and be willing to pay more for their food, so a more ecological way of cultivation could be financed.

Sources

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