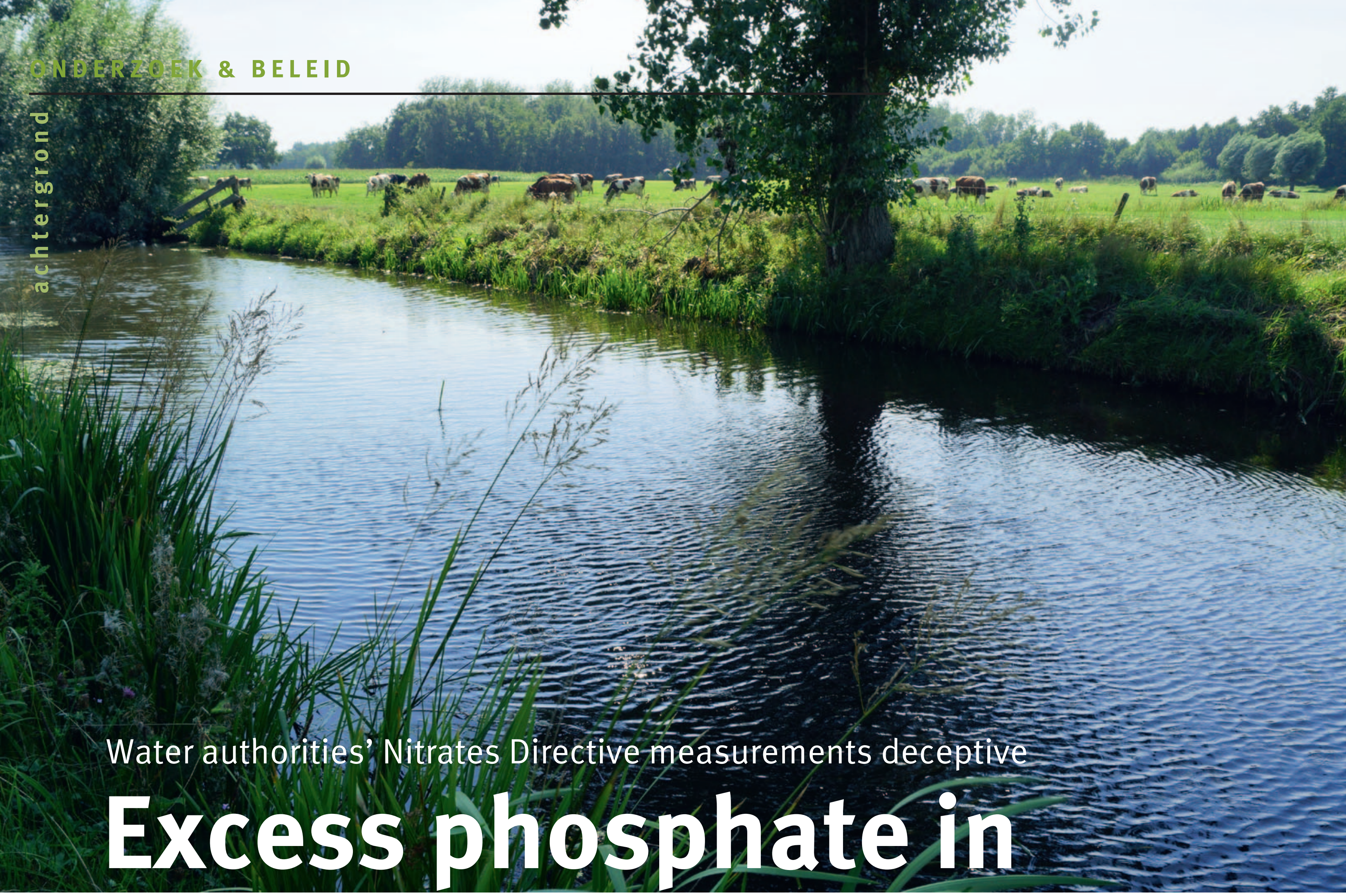


Water authorities' Nitrates Directive measurements deceptive

Excess phosphate in water caused by seepage

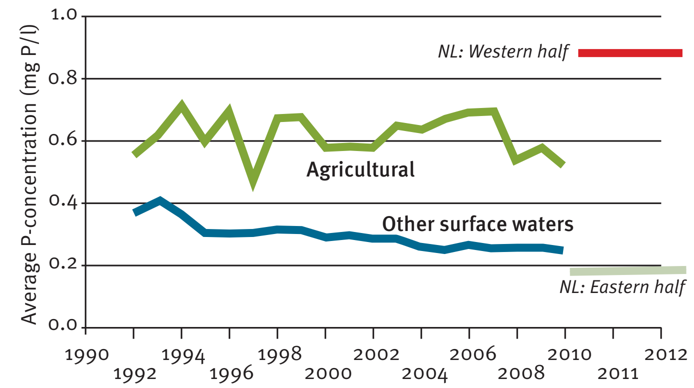
A significant excess of phosphate concentrations in surface water was not caused by over-fertilised soils, but by phosphate-rich seepage water from a Pleistocene marine deposit in the ground. This source was not included in reports from the national government for the Brussels Nitrates Directive, and the phosphates were attributed to agriculture only. About half of the sewage treatment plants also discharge more phosphates into surface water than the government assumed. For years, agriculture has therefore been blamed for phosphate emissions for which it is not responsible. This summer, V-focus investigated the basis of phosphate policy (phosphate rights) with tests based on actual measurements in the environment.

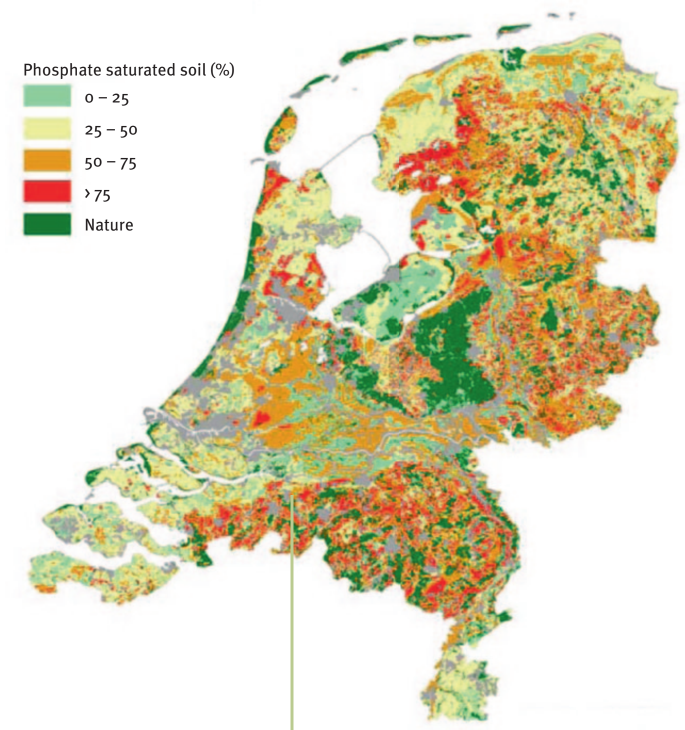
Geesje Rotgers

'The quality of agricultural surface waters affected by phosphate is still significantly different from the general water quality *(see Figure 1)*. This is related to the accumulation of phosphate in agricultural land in the past. In rural areas, a significant portion of the phosphate pollution of surface water is due to leaching from the soil, as announced by the central government in its *Fourth Dutch Nitrates Directive Action Programme (2010-2013)*. This is strong language based on assumptions largely derived from mathematical models. In the *Fifth Action Programme (2014-2017)*, disappointment is expressed at the lack of results. The years of rigorous fertilization regulation show only a slight improvement in water quality. The Netherlands Environmental Assessment Agency, part of the Ministry of Infrastructure and the Environment, confirmed the high levels of pollution, with 65% of phosphates in regional waters coming from agriculture and 20% from sewage treatment. Given the considerable impact that the forthcoming phosphate policies will have on livestock farming, V-focus decided to use actual measurements to review the policy assumptions. The MNLSO measurements of the water authorities are the principal method used for reporting to Brussels under the Nitrates Directive.

Figure 1

Average phosphorus concentrations in surface waters (in mg P/litre) according to the Fifth Dutch Nitrates Directive Action Programme. Supplemented by V-focus with large differences in concentration between the western half (red) and eastern half (green) of the Netherlands. Measurements by water authorities





PHOSPHATE SATURATED SOIL

The soils in the eastern half of the Netherlands are much more heavily saturated with phosphate than those in the western half.

Map: Fourth Dutch Nitrates Directive Action Programme

MNLSO monitoring network: strange results

The quality of water in agriculture specific waters still leaves much to be desired. This spring, the research institute Deltares said 'There is a visible improvement, but at half the 173 monitoring sites, the water quality does not yet meet the phosphate standards of the water authority'. In 2011, the water authorities, together with the Ministry of Infrastructure and the Environment, Deltares and Rijkswaterstaat established the *Meetnet Nutriënten Landbouw Specifiek Oppervlaktewater (Monitoring Network for Agriculture Nutrient Specific Surface Water) (MNLSO)*. The 173 surface sampling points in this network were chosen in such a way that almost all the phosphate in the water derived from human activity comes from agriculture. The MNLSO monitoring network strongly influences the Dutch phosphate policies because the results are used for policy evaluations of the *Brussels Nitrates Directive and the Water Framework Directive*.

V-focus analysed the latest available data from the MNLSO (2011-2013) and divided the measurements according to sand, clay and peat lands, and from summer and winter measurements *(see Figure 2)*. These measurements showed that much higher P concentrations are found in the peat and clay areas than in sandy regions. In all areas, the average values were well above the targets in artificial waters (0.15 mg P/litre for channels and 0.22 mg P/litre for farm ditches).

When the test results are examined by region, it appears immediately that something strange is going on *(see infographic, page 24-25)*. The waters in the western half of the Netherlands are much more contaminated than those in the eastern half. In the west, there is, on average, more than four times as much phosphate in the surface water as is found in the east. This is an extremely big difference. How can agriculture alone be the cause? It is remarkable that the Fifth Action Programme for the Nitrates Directive did not report on this difference, but instead presents a national average of about 0.5 mg P/litre in rural areas, while it really amounted to only 0.2 mg/litre in the eastern half and over 0.8 mg/litre in the western half *(see Figure 1)*.

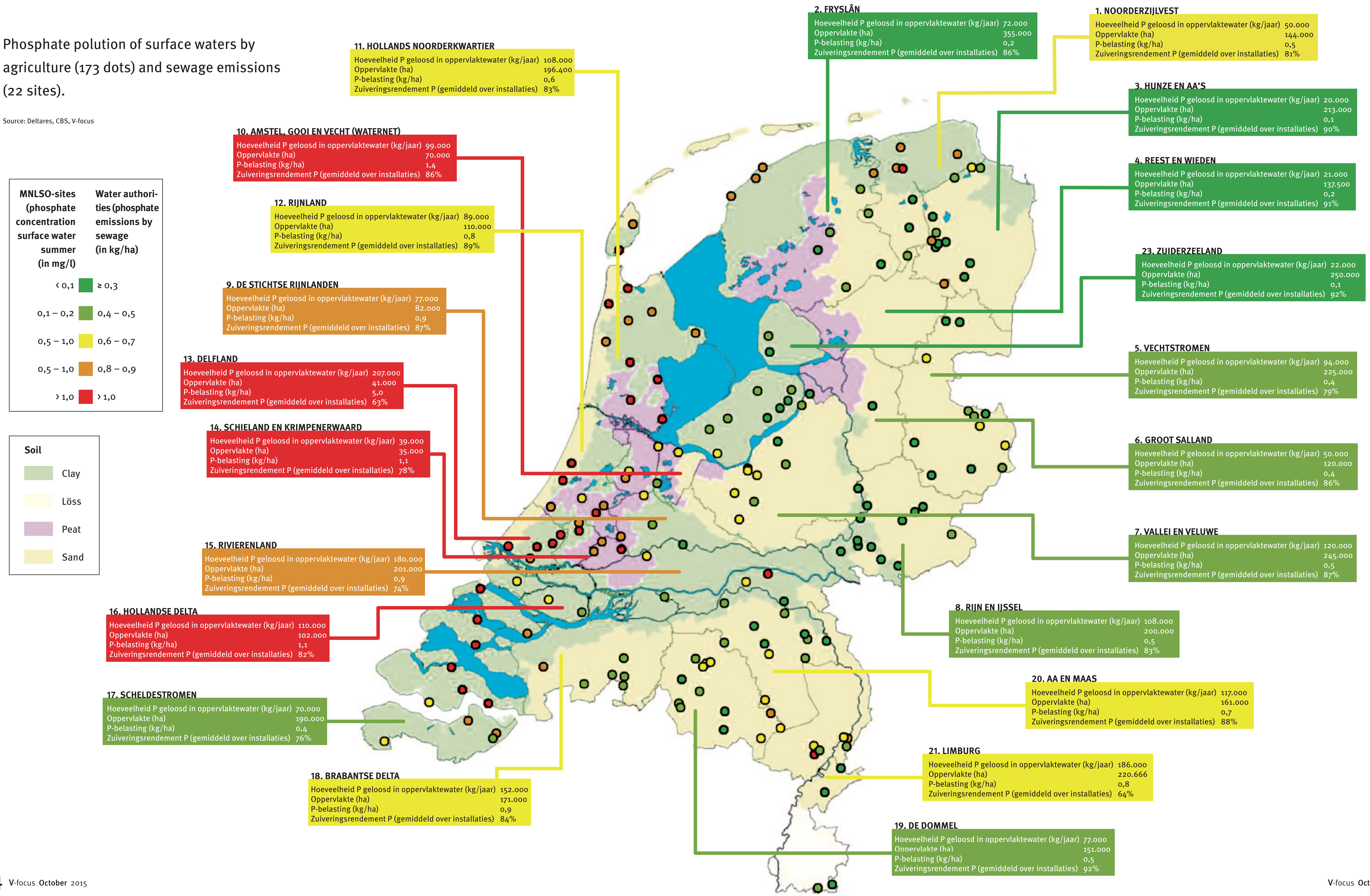
The Deltares Research Institute identified the big difference between the east and west halves of the country, but Joachim Rozemeijer, researcher in hydrology and water quality, had no explanation for this. Within the MNLSO, they only determine the concentrations and trends of high nutrient concentrations, without looking for causes. Looking for explanations for measured results thus falls outside their terms of reference. This is curious, since the search for explanations of different results is standard practice in research.

LMM monitoring network measured half the level of phosphate

The Netherlands has a second water monitoring network: since 1992 the water quality on farms has been measured by the *Rijksinstituut voor Volksgezondheid en Milieu (National Institute for Public Health and the Environment) (RIVM)*. That takes place within the framework of the *Landelijk Meetnet Effecten Mestbeleid (Dutch Minerals Policy Monitoring Programme) (LMM)*. RIVM distinguishes between the farm and soil type. There are several hundred farms in the network and water is sampled in ditches and in water leaching from the root zone. V-focus analysed the ditch water measurements in 2011-2013 (the same period as MNLSO). No summer measurements for peat soils were

Phosphate polution of surface waters by agriculture (173 dots) and sewage emissions (22 sites).

Source: Deltares, CBS, V-focus



available for this period, and here measurements were taken from 2010. The results are shown in Figure 2. The figure shows that the target of a maximum of 0.15 mg P/litre in sandy soils was fairly well achieved. On peat soils the P emissions in the surface water appear to be a little too high, and on clay there is a big problem of phosphate in the summer.

Although MNLSO (the water authorities) and LMM (RIVM) both claim to measure the effects of mineral policy on the surface water, the MNLSO reported values which were more than twice as high. Coincidence or not, a week after V-focus raised this issue with the Dutch Environmental Assessment Agency, their work partner RIVM presented a report about it online: the water authorities used a different sampling method (unfiltered samples instead of filtered) which resulted in 80% higher outcomes. The method of sampling thus makes a world of difference. It is highly questionable whether the water authorities are sampling appropriately. By not filtering the water samples, phosphates in small water creatures and plant remains scooped out of the water with the sample are also included in the results. These phosphates are at present attributed to agriculture. Earlier reports (2009) indicate that at that time, RIVM tried to force its method on the water authorities, but they decided otherwise. The conclusion is that if measurements had been made using the RIVM method, the phosphate problem would have been smaller by half. In that case, the phosphate targets would have already been achieved in many parts of the country.

Because MNSLO is leading in the evaluations for the Nitrates Directive, we will have to rely on the measurements of this network.

No relationship with P-saturated soils

According to the government, the P-saturated soils could provide a significant contribution to the P-load of surface waters. Based on the MNLSO measurements, the phosphate-saturated soils would be expected in the western Netherlands, but that is not the case. The opposite appears to be true: the soils with the highest phosphate saturation are found precisely in the sandy areas where livestock are reared, such as the Achterhoek, Brabant and Gelderland Valley *(see map of the Netherlands)*. But here, the quality of the surface water is generally good. Based on MNLSO data, we can only conclude that there is a significant inverse relationship between the quality of surface water and the phosphate saturation of the soil. The leaching of saturated soils apparently plays such a small role in water quality that it is not reflected in the MNLSO-monitoring network.

Contribution of sewage under-estimated?

To test whether the MNLSO measurements in the western Netherlands may be contaminated with sewage emissions, phosphate discharges are collected by the water authority. The Netherlands has about 350 treatment plants which discharge their effluent into the regional surface waters. On average, plants filter 84% of the phosphate out of the sewage, so the remaining 16% is discharged into surface waters *(source: CBS)*. The purification efficiency of the equipment varies considerably between water authorities. The average yield of the Delfland Water Authority plants are shockingly low: only 63%. In combination with the high population density in the region around The Hague, this results in a substantial level of pollution of the surface water (5 kg P/ha). On average, sewage treatment plants throughout the Netherlands discharge 0.6 kg/ha/year *(see infographic page 24-25)*.

The performance of the water authorities is in remarkably good agreement with the measurements within the MNSLO: good performance in the eastern Netherlands, moderate in the west. The measurement results of the MNSLO appear to reflect the functioning of the local sewage treatment. Researcher Rozemeijer from Deltares thinks that sewage treatment is irrelevant. "The MNLSO consists of measuring locations which have agriculture as the sole human source." Delfland Water Authority also seeks the cause outside their area of responsibility. "We are aware of the high phosphate levels in our water and have investigated the sources. A significant part comes from horticulture or agriculture, by leaching from soils." It should be noted here that leaching from soils is calculated through mathematical modelling.

Largest natural source overlooked

There is another source that can provide a lot of phosphate in surface water: seepage. Since the last ice age, the sea has caused many changes in the Dutch coastline by depositing sediments in many places, resulting in the emergence of phosphate-rich seepage.

Seepage water may contain high concentrations of phosphate, of more than 1 mg/litre, as reported in historical hydrological research documents. In 1990, the then Ministry of Transport calculated annual phosphate pollution of surface waters by seepage at 3.4 million kilograms per year. That is equivalent to the total load that is now being attributed by Wageningen University (July 2015) to Dutch agriculture. Seepage is now a forgotten source in agricultural reports on phosphate emissions to surface water. This seepage is still mentioned in some reports, but it is considered as a local issue and of minor significance at national level.

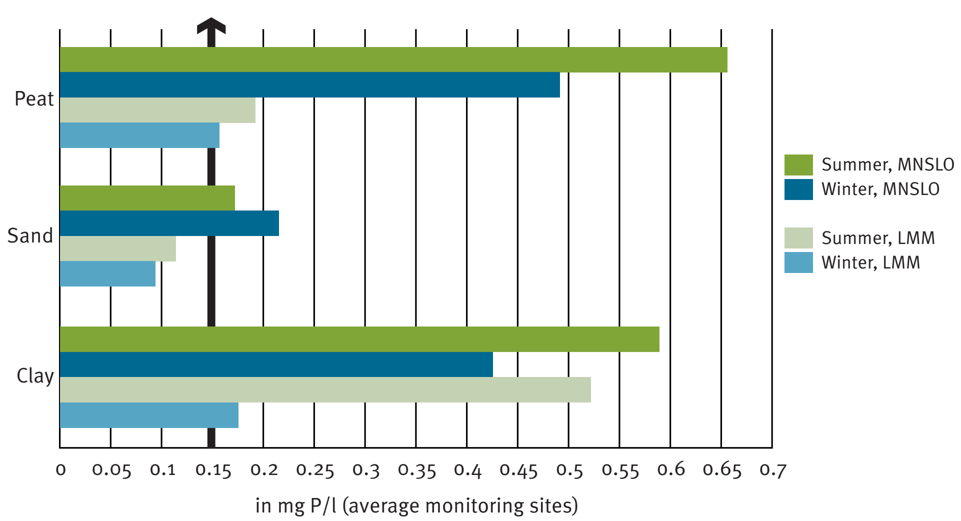
When we study the MNLSO measurements *(see infographic, page 24-25)*, the total national emissions from agriculture and seepage are about equal. This assumes that agriculture does not differ substantially between the east and west of the Netherlands. This means that the amount of seepage calculated in 1990 by the Ministry of Transport still applies.

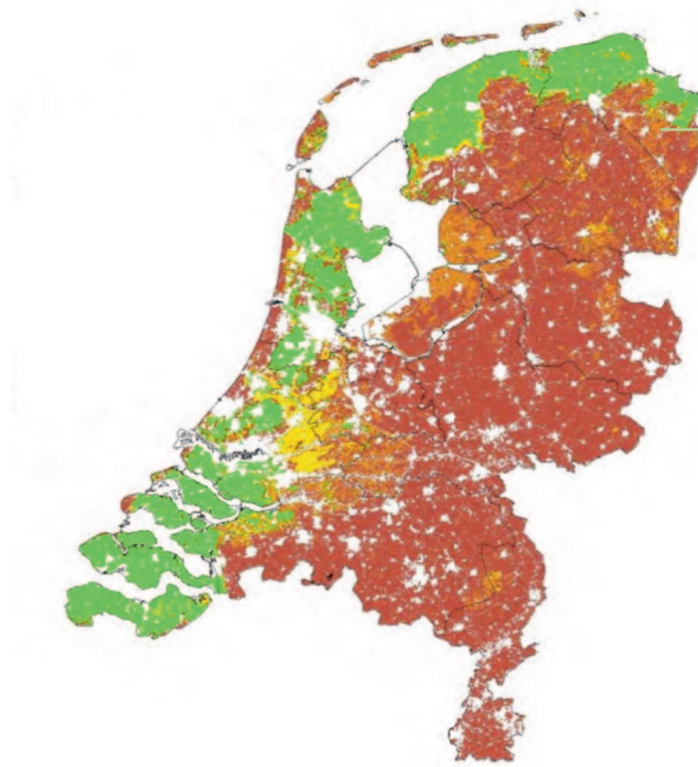
When the MNSLO measurement values are corrected for seepage, it results in an average emissions value from agriculture for the Netherlands of 0.6 kg/ha. This figure is equivalent to emissions from sewage treatment. Finally, there are the sewage overflows and *Individuele Behandeling van Afvalwater* (small wastewater treatment plants) (IBAs), which together account for about 0.2 kg/ha *(source: Rijkswaterstaat)*.

As long as the water authorities attribute phosphate emissions to agriculture which very probably do not originate from this source, the MNLSO is unsuitable for the purpose for which it is currently deployed by the Ministry of Infrastructure and the Environment: measuring the effectiveness of the fertilizer policy under the *Brussels Nitrates and Water Framework Directives.*

Figure 2

Comparison measurement results MNLSO monitoring network (Ministry of Infrastructure and the Environment, Water Authorities, Deltares) and LMM monitoring network (RIVM), for sand, clay and peat (0.15 mg P/litre target for many surface waters).





SEEPAGE AREAS

The western and northern Netherlands are affected by phosphate-rich seepage (heavy seepage: green on the map, some seepage: yellow). High P-concentrations are measured in the surface water in the same areas. Is there a connection?

Map: Alterra Wageningen UR

CONCLUSION

1. According to the *Dutch Action Programme for the Nitrates Directive*, saturated soils (caused by decades of over-fertilisation) play a major role in the phosphate pollution of regional surface water. The official measurements of the Ministry of Infrastructure and the Environment for the *Nitrates Directive and the Water Framework Directive* (the MNSLO-network) prove the opposite to be the case at national level. There is even a significant inverse relationship between phosphate saturation of the soil and phosphorus in surface water.
2. The phosphate concentration in the 'agriculture-specific waters' in the western half of the Netherlands is on average more than four times as high as in the eastern half. It is very likely that 75% of the measured phosphates come from sources other than agriculture. The MNLSO identifies the very different values, but fails to provide an explanation. It does not seek an explanation for very different readings, but in charts suggests that this unexplained 'surplus' comes from agriculture *(see Figure 1)*, which, in the view of V-focus, constitutes deception.
3. The MNLSO readings are heavily polluted by sources outside agriculture. This monitoring system should not be used for its current purpose: monitoring the effects of phosphate for Dutch policy under the *Brussels Nitrates and Water Framework Directives*.