

## **Agricultural phosphorus regulation in Europe**

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## **Experience-sharing for 4 European countries**



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Office  
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## ABSTRACT

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Phosphorus, widely used in agriculture, is mainly provided to crops by mineral fertilizers that come from phosphate rocks. The reserves of phosphate rocks are limited and unequally distributed on earth. The management of this resource is therefore crucial. Moreover, excessive use of fertilizers can contribute to water bodies' pollution and can result in a phenomenon known as eutrophication.

The phosphorus issue is a growing topic. Currently, there isn't any European Directive on the agricultural phosphorus to ensure its good management and use. Some regulatory frameworks exist but they do not regulate directly phosphorus. However, some European countries have a national legislation that aimed to regulate the agricultural phosphorus. It would be interesting to see how the question is handled in different countries. A bibliographic analysis on the agricultural phosphorus regulation were carried out, supplemented by interviews conducted in four European States: Germany, the Netherlands, Denmark and Italy.

Globally, the results show that regulatory framework in Europe is strongly heterogeneous. There is a diversity among the systems used to regulate phosphorus (nutrient balance, application standards). Some of those regulations, sometimes old, have been recently modified.

For each country studied, a sharing experience gives an overview of how the topic is treated and how it is perceived.

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## 1. Introduction

Phosphorus, widely used in agriculture, is mainly provided to crops by mineral fertilizers that come from phosphate rocks. The reserves of phosphate rocks are limited and unequally distributed on earth. There are mainly located in Morocco, China and United States. Morocco have a reserve of 50 million tons, followed by China and United States that hold 3.3 and 1 million tons respectively<sup>1</sup>. In Europe, the main reserve is located in Finland. The access and management of this resource are therefore crucial.

Moreover, excessive use of fertilizers can contribute to water bodies' pollution and can result in a phenomenon known as eutrophication. It is characterized by the overproduction of organic matter, causing an overgrowth of algae and consequently a depletion of the oxygen of the water, which can lead to the death of aquatic organism.

The phosphorus issue is a growing topic. Currently, there isn't any European directive on agricultural phosphorus to ensure the good management and use of this resource. Only few regulatory frameworks exist but they do not regulate directly phosphorus. Some European countries have a national legislation dealing with agricultural phosphorus. The aim of this study was to better understand how several countries regulate the use of agricultural phosphorus. Do they have a national regulation on agricultural phosphorus? Do they assess the efficiency of their regulation? How stakeholders perceive the regulation?

To answer these questions, a bibliographic analysis on the agricultural phosphorus regulation was carried out, supplemented by interviews conducted in four European Member states: Germany, the Netherlands, Denmark and Italy (Tuscany region). These countries were selected in order to have a diversity of situation in Europe and to compare how the phosphorus issue is managed. Interviews have also helped to understand the perception and the relationship between stakeholders in a same country. Detailed factsheet (compilation of bibliography and interviews elements) are available for each country as well as a cross analysis between the four countries.

*Point of attention: The elements proposed hereafter for the different countries do not claim to be exhaustive. Furthermore, the elements coming from the interview reflect the point of view of a single stakeholder for the country concerned.*

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<sup>1</sup> Jasinski, S.M., 2017. Phosphate Rock, Mineral Commodity Summaries, U.S. Geological Survey <[minerals.usgs.gov/minerals/pubs/commodity/phosphate\\_rock/](http://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock/)>

## 2. Factsheets

### 2.1 Denmark

#### 2.1.1 Context

Phosphorus surplus in the aquatic environment is considered as a problem in Denmark. However, until now the focus regarding phosphorus has mainly been on wastewater treatment, and wastewater from houses and from the industries. In an agricultural context, the focus has mainly been on regulation of nitrogen.

But the importance given to phosphorus is growing during the past years. The regulation on nitrogen has been really attended and the focus on agricultural phosphorus has sharpened. Indeed, phosphorus from the agriculture sector is a source for eutrophication, mostly linked to surface and inner waters.

#### 2.1.2 Phosphorus regulation

In Denmark, the first Action Plan for the Aquatic Environment (APAE I) was introduced in 1987. APAE II followed in 1998, then APAE III in 2004 (Table 1). The APAE is related to nutrient losses from both agriculture and wastewater. However, focus regarding phosphorus were primarily on wastewater losses in APAE I and II (the second as a response to the Nitrates Directive).

With the third Action Plan (as a response to the Water Framework Directive and Nitrates Directive), also agricultural phosphorus was tried regulated through voluntary buffer zones and wetlands, however with a very low success rate, and some initiatives to reduce the phosphorus content in animal manures. The third Action Plan (2004-2009) included a stronger focus on phosphorus surplus in agriculture, and is the first action plan to directly regulate application of phosphorus in agriculture<sup>2</sup>. An example of this was a tax on mineral phosphates for animal feed (Statutory instrument no 1290 05/11/2016). The tax is 4 DKK/kg of mineral phosphorus (0,53€) (Andersen, 2017). The tax has generally resulted in a reduced phosphorus excretion by animals and the tax is still in force.

Name of the regulation	Aims <sup>3</sup>
<b>NPO Plan<sup>4</sup></b> (Nitrogen Phosphorus and Organic Matter) - 1985	Focus on direct pollution from farms regarding both nitrogen and phosphorus. Most important regulation were: Requirement of storage capacity for manure and rules due to dates for application of manure (within the growing season). Balance between numbers of animals and

<sup>2</sup>

<https://phosphorusplatform.eu/images/download/Report%20PhosphorusProject%20Denmark%20for%20ESPP.pdf>

<sup>3</sup>

<http://eng.mst.dk/trade/agriculture/nitrates-directive/implementation-in-denmark/>

<sup>4</sup> Danish version can be found here: <https://baeredygtigtlandbrug.dk/media/85079/npo-redeg%C3%B8relsen.pdf>

	application area for manure (the harmony rules, defined here as 170 kg N/hectare).
<b>Harmony Rules (since 1985)</b>	It implements parts of the Nitrates Directive, the measure 170 kg N/ha, and aims to balance the livestock manure production. Tightened with the APAE II.
<b>APAE I</b> (Action Plan on Aquatic Environment) - 1987	Continue the NPO plan. Reduction of P leaching from sewage treatment and reduction of N leaching.
<b>APAE II</b> (Action Plan on Aquatic Environment) - 1998	Requirement of balance between numbers of animals and application area for manure is tightened to 140 kg N/ha for pig and poultry production, 170 kg N/ha for cattle production and 230 kg N/ha as exemption for some cattle production. Implementation of an N-quota system per farm dependent on crop choice as a maximum for application of N per hectare. Requirement for each farmer to do manure accounts.
<b>APAE III</b> (Action Plan on Aquatic Environment) - 2004	Reduction of P surplus from agriculture (reduction of 50% by 2010) and reduction in N leaching (reduction of 13% in 2015 compared to 2003).  A tax put on mineral phosphorus in feed (DKK 4 per kg of mineral phosphorus).  Reduction in phosphorus discharges with a voluntary 10 m buffer zones <sup>5</sup> along the watercourse.
<b>Green Growth Agreement (GGA)</b> – 2009	10 m mandatory buffer zones, subsidies for voluntary implementation of e.g. wetland areas.
<b>Phosphorus regulation (from 2018)</b>	New phosphorus regulation established direct P ceilings at farm level

Table 1: Main regulations on agricultural P in Denmark (Ministry of Environment and Food of Denmark Environmental Protection Agency, 2012)

In 2008, the APAE III was evaluated and it shows that the “expected goals” weren’t achieved<sup>6</sup>. So, in 2009, the APAE III was replaced by the **Green Growth Agreement (GGA)** that also aims to regulate the nutrient loss.

**The Harmony Rules** (Statutory instrument no 906 14/10/1996) set up since 1985, are the Danish regulation of livestock holdings establishing “a minimum size of area for livestock holdings” (a balance between the number of animal units and the agricultural area). The Harmony Rules implements the

<sup>5</sup> <http://eng.mst.dk/trade/agriculture/nitrates-directive/action-plan-for-the-aquatic-environment-iii/>

<sup>6</sup> <http://eng.mst.dk/trade/agriculture/nitrates-directive/implementation-in-denmark/>

Nitrates Directive limitation of 170 kg N/ha/yr for the land application of livestock manure. In Denmark this limitation were tightened in the APAE II and in 2017 relaxed to 170 kg N/ha.

Until 2017 there has been no direct P legislation although the P application from manure was indirectly restricted due to the limits of 140/170/230 kg N ha<sup>-1</sup> yr<sup>-1</sup> for the whole Danish territory (due to the Danish implementation of the Nitrate Directive). The general limit was 140 kg N ha<sup>-1</sup> yr<sup>-1</sup> for the use of animal manure, 170 kg N ha<sup>-1</sup> yr<sup>-1</sup> for cattle/dairy manure and 230 kg N ha<sup>-1</sup> yr<sup>-1</sup> for cattle/dairy under derogation<sup>7</sup>. However, this has been changed in 2017 to 170 kg N/ha for all animal units as in other countries and 230 kg N ha<sup>-1</sup> yr<sup>-1</sup> for cattle/dairy under derogation. Due to the N limitations above, P was indirectly regulated via the amount of manure-N which can be applied and the N/P ratio in the manure, varying per livestock type.

The last Danish derogation (for application of 230 kg N/ha for some cattle farms) has been granted under some particular conditions suggested by the Danish government, including that “from August 2017 a phosphorus regulation shall enter into force establishing direct phosphorus ceilings at different levels throughout the country depending on geographical location and fertiliser type. Ceilings shall cover application of phosphorus from all types of fertilisers: organic fertilisers, including manure, biogas digestate, degassed plant biomass, sludge from sewage water treatment as well as industrial fertilisers. Stricter phosphorus application ceilings covering all types of fertilisers shall be applied in catchments of phosphorus vulnerable aquatic environment”<sup>7</sup>.

A political agreement in December 2015, which has been put into force on August 1<sup>st</sup> 2017 (Statutory instrument no 865 23/06/2017), changes the indirect limits into fixed phosphorus standards (Table 2). This legislation covers all types of organic fertilisers as well as mineral phosphorus fertilisers. From 2018, the phosphorus ceilings range between 30 and 43 kg P/ha, according to the type (Table 2). The phosphorus regulation is part of the implementation of the Nitrate Directive.

The stricter P ceilings in Table 2, expectedly covering up to 24% of the total agricultural area, will apply to farms with areas located in catchment areas of large lakes with known catchments included in the River Basin Management Plans (RBMPs) vulnerable to phosphorus. The vulnerability is defined as larger lakes with risk of changing ecological status due to the definitions in the Water Framework Directive.

Kg P/ha <sup>b</sup>	Current harmony rules, recommendations (2015)	2017-2020 (strict ceilings from 2018)		2020-2022 <sup>a</sup>	
		General (76% of area)	Strict (24% of area covering catchments of P-vulnerable AE)	General (76% area)	Strict (24% of area covering catchments of P-vulnerable AE)

<sup>7</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D0847&from=EN>

Kg P/ha <sup>b</sup>	Current harmony rules, recommendations (2015)	2017-2020 (strict ceilings from 2018)		2020-2022 <sup>a</sup>	
Poultry	Up to 55	43	30	35	30
Mink	43	43	30	35	30
Slaughter pigs	34	39	30	35	30
Sows and piglets	Up to 37	35	30	35	30
Cattle	27	30	30	30	30
Derogation farms	36	35	35	35	35
Organic waste	30	30	30	30	30
Industrial fertilizer	No limit	30 <sup>b</sup>	30 <sup>2</sup>	30 <sup>2</sup>	30 <sup>b</sup>

a The ceilings for mink and poultry will already be applied from January 2019.

b The total amount of mineral fertiliser for the harmony area can be adjusted with the amount of mineral fertiliser used on area not accounting to the harmony area (Statutory instrument no. 1011 22/06/2018, §47).

*Table 2: Recommendations and Regulations about the application of agricultural phosphorus in Denmark (Ministry of Environment and Food of Denmark Environmental Protection Agency, 2017)*

The difference between 30-43 kg P/ha depends on the manure type and that is because the content of phosphorus is different between the different types of manure.

Here is how a farmer has to calculate the minimum area he must have to apply his P and N fertilizers:

$$\frac{\text{Sum of } P \text{ orga (kg)}}{\text{ceiling } P \left(\frac{\text{kg}}{\text{ha}}\right)} + \frac{P \text{ mineral applied (kg)}}{\text{ceiling } P \text{ mineral} \left(\frac{\text{kg}}{\text{ha}}\right)} = X \text{ ha}$$

$$\frac{\text{Sum of } N \text{ orga (kg)}}{\text{ceiling } N \left(\frac{\text{kg}}{\text{ha}}\right) (=170 \frac{\text{kgN}}{\text{ha}})} = Y \text{ ha}$$

Since 2017, the farmer has to comply with these two different rules, whereas before he only had to comply with the N equation.

The quota in Table 3 can be increased if the farmer can prove that the soil P number is very low: below 4.0 mg P/kg of soil. With decreasing soil-P the quota can be increased at a maximum of 14 kg P/ha. The total farm quota cannot exceed 45 kg P/ha.

Average soil-P for the farm (mg P/kg of soil)	Kg P/ha in addition to the farm quota
4.0-3.5	+1 kg P/ha
3.49-3.0	+2 kg P/ha
2.99-2.75	+4 kg P/ha
2.74-2.50	+6 kg P/ha
2.49-2.25	+8 kg P/ha
2.24-2.00	+10 kg P/ha
1.99-1.75	+12 kg P/ha
Below 1.75	+14 kg P/ha

Table 3: Allowed P (kg/ha) according to the soil P-contents (Ministry of Environment and Food of Denmark Environmental Protection Agency, 2017)

In Denmark there are also some recommended limits for the agricultural sector for application of phosphorus. But it is just recommended levels per crop type, that it is possible to find in the Danish guidance about fertilisation and harmony rules, the newest valid for the season 2017/2018 ("Vejledning om gødsknings- og harmoniregler. Planperioden 1. August 2017 til 31. juli 2018").

As part of the Danish implementation of the Nitrates Directive and the Water Framework Directive, farmers are offered subsidies, from the Ministry, for implementation of phosphorus wetlands through Agri-Environmental Schemes (AES). The purpose of implementing phosphorus wetlands is to reduce leaching of phosphorus to specific phosphorus sensitive lakes. A phosphorus wetland is established through re-establishment or change of existing streams to secure natural flooding of the nearby areas facilitating precipitation of phosphorus. Voluntary phosphorus wetlands are to reduce phosphorus leaching to the lakes by 5,000 kg yr<sup>-1</sup> and are to be implemented during 2016-2021. 84 million DKK are earmarked for the implementation.

#### ○ **NATURA 2000:**

From 2007 and until 2017 there have been fixed standards for phosphorus surplus for husbandry farms in P vulnerable NATURA 2000 areas. The fixed standards came into force through the environmental assessments for getting a permit to expand livestock production.

The fixed standards were coupled to the farm phosphorus surplus and differentiated due to the soil P numbers. The regulation were part of the water Action Plan III, now replaced with the new P regulation.

#### ○ **Sludge use:**

It is not allowed to use non-treated wastewater sludge as fertiliser in Danish agriculture (Statutory instrument no 843 23/06/2017). If stabilised (different anaerobic or aerobic treatments, composting, chemical treatment) /controlled composting (composting at a minimum temperature of 55 degrees for

minimum two weeks), it is allowed used for non-consumable crops. A year after application it is only allowed to cultivate cereals and seed crops, grass and other crops for production of dry food (i.e. it is not allowed to cultivate potatoes, corn, sugar beets etc.). If hygienic controlled (e.g. treatment in biogas reactor, use of incinerated lime plus control for salmonella, E.coli and enterococcus), wastewater sludge can be applied to all crop types.

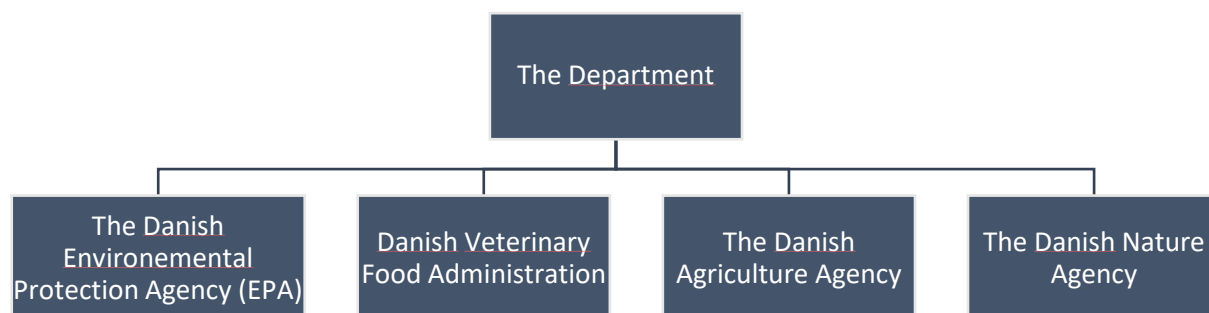
- **Wastewater Reuse:**

Likewise, most of the wastewater in Denmark (from households, roof surfaces and other areas, and industrial water water) is purified. A smaller part of the water is reused in private households and in the industry. They have used ground- and drinking water over time for other purposes than drinking water. However, the larger cities are challenged due to extraction of clean groundwater for drinking water, why the interest for reuse have increased. Climate changes and an increased environmental awareness is part of the interest for reuse of waste water as well.

### 2.1.3 Implementation modalities

The Ministry of Environment and Food is responsible for the protection of the environment, the agriculture and the food production (national scale). The Ministry includes 4 agencies: the Danish Environmental Protection Agency, The Danish Veterinary and Food Administration, The Danish Agriculture Agency (control as well as responsible for some statutory instruments and subsidy schemes) and, The Danish Nature Agency.

At regional and local scale the delegation is done to the municipalities.



*Figure 1. Danish governance on agricultural phosphorus*

Every year, the Danish Agriculture Agency publishes guidelines for the farmers to see how the production of N and P on the farm is estimated for use in the P and N regulation. Those publications includes explanations on how the quotas should be read and information if there is any changes in the regulation. With the new phosphorus regulation, this guideline is improved so farmers can read how to

do it with a lot of examples on how to report in the fed crops type, how to report on N and P, animal units, crop plan and how to measure the animal unit. There are a lot of information they should provide on stable types and information to measure the phosphorus quota correctly. Every year a new guideline is published updated with changes and new initiatives.

Also, farmers report every year their use of nitrogen and phosphorus, crop rotation pattern, number and type of animals etc. to the Danish Agricultural Agency. They communicate through the Danish EPA as well as through the Danish Agricultural knowledge centre, SEGES (<https://www.seges.dk/en>). SEGES is the main supplier of professional knowledge for the agricultural professions, within all areas of farming. It is not linked to the Ministry it is more from the private sector but it is an agriculture Agency where they do a lot of agriculture research and guide the farmers on how to fertilize, what to use and how much, and also on how to measure the soil P number and how to adjust the application of phosphorus.

The communication goes through the Danish EPA, SEGES, as well as through the Danish Agriculture and Food Council, which represent the farming and food industry of Denmark including companies, trade and farmers associations. SEGES also communicate directly with the farmers as well as through farmer consultants.

In relation to the new P legislation, a range of information campaigns has been carried out from the Ministry and from The Danish Agriculture and Food Council to inform about the new rules.

## 2.1.4 Compliance with regulation

The monitoring structure in Denmark is The Danish Agricultural Agency. They do online verification but, besides administrative controls, the Danish Agriculture Agency also inspects farms on-site.

The Danish Agricultural Agency is the control unit regarding N and P applied in the agriculture. The municipality is the control unit regarding other legislation e.g. specific dates for application of manure and use of fertilizer technologies. Due to phosphorus it will be onsite inspection of the reported P in manure (animal units), contracts for selling/ buying manure, soil-P tests, and feed control.

This Agency checks up every year if all the information online are correct. The fertilizer account (Godningsregnskaber) is part of the old nitrogen regulation where they had to calculate a quota, deleted a couple of years ago. But now they use it for the new phosphorus regulation and for the CAP payments. The Danish Agriculture Agency verifies the mandatory signing up.

The year after the growing season at March 31, the farmer is required to report P-production, P-use, received P etc. to the authority - Ministry of Environment and Food, The Danish Agricultural Agency (i.e. the former Danish AgriFish Agency).

If farmers do not comply with regulation they have penalties. It can be a fine, for example if the information online is not right they can reduce the CAP payments and due to the P ceiling it will be a sort of fine if they do not report correctly. Regarding the new P legislation, a hearing process is ongoing due to the specific controls and penalties. This will be decided within a short horizon. However, it can be assumed that the P legislation will mimic the control and penalties of the Danish Nitrogen legislation. Possible sanctions are administrative penalties.

### 2.1.5 Efficiency

In Denmark they have the National Monitoring Programme for Water and Nature (NOVANA). This monitoring programme was established in 1987 as part of the first Water Action Plan, and monitors the state and development of the environment: water, air and nature (however, with different names and focus through time). NOVANA is administered by the Danish Environmental Agency. It is part of the fulfilment of Danish, EU and international conventions about monitoring. Specifically NOVANA monitoring helps developing and monitoring the Danish Water Management Plans and helps to analyse the effect of the different environmental policies. During the period 2017-2021 NOVANA constitute more than 250,000 measurements every year at more than 35,000 stations across the Danish territory.

NOVANA is a programme that has existed for many years.

NOVANA constitute two different purposes, 1) monitoring due to the general state of the environment and, 2) monitoring of surface and groundwater where there is a risk of non-compliance due to the environmental targets e.g. the Water Framework Directive. These specific sites are monitored every year.

As the phosphorus regulation is rather new, an evaluation have not been carried out yet. However, the legislation will be evaluated along with the now out phased legislation.

### 2.1.6 Farmers perception on regulation

The P regulation is new so there is not any feedbacks on it yet. Agriculture is already heavily regulated due to Nitrogen regulation and have been so since the 80's, i.e. farmers are used to report to the Agricultural Agency about crop choices, use of fertiliser type and amount, number and type of animals. So, according to the interviewed person, *"this is not new to them that they should report on phosphorus as well. It is just a bit more time consuming but they are used to this reporting in. However, they are not used to the new P regulation, which is an add-on to the Nitrogen report they are forced to do."*

### 2.1.7 Other measures

The phosphorus legislation was introduced along with changes in the Danish Nitrogen regulation as e.g. the increase of the ceiling from 140 kg N/ha to 170 kg N /ha. According to those changes, a range of dissemination activities is conducted from the Ministry as well as from The Danish Agriculture and Food Council.

In Denmark, farmers are not really aware of phosphorus as a problem from the agriculture sector. They are in general very aware on phosphorus emissions connected to wastewater, whereas agricultural P in general is considered a smaller problem among farmers.

They do not have additional measures beyond the legislation. But they have, through the Agri Environmental Schemes (AES), some subsidies from the Ministry to establish P (mini) wetlands. Phosphorus mini wetlands are small constructed ponds and most of them are implemented next to agricultural areas but not on cultivated lands. It corresponds to places where there is artificial drainage that will somehow filter the phosphorus.

Concerning the buffer zones there was an evolution. In 2003 with the APAE it was a voluntary 10 m buffer zone with a compensation for arable land of 300 € per year and grassland 150 € per year. In 2012, the Buffer Strip Act sets up a 10 m mandatory buffer zone. In 2014 the 10 m buffer zone was reduced to 9 m buffer zone. And from 2015 only a 2 meter buffer zone is kept mandatory due to classified lakes and streams in statutory instrument no. 127 26/01/2017 or no. 934 27/06/2017 or identified due to the RBMP's<sup>8</sup>. Buffer zones can be used as part of the CAP fulfilment of green requirements as well as a substitute for the Danish requirements of catch crops.

## 2.1.8 Perspective

The current regulation is quite new so there are not any plans besides and evaluation in a couple of years. But it is evaluated continuously. The Ministry of Environment and Food is currently running a large phosphorus project evaluating the P ceilings, as well as mapping P in Denmark and investigate different P transport ways.

The new regulation is going to be evaluated as well but since it only started last year there is not a real feedback on it.

## 2.2 Germany

### 2.2.1 General questions

Phosphorus has been identified as an environmental issue in Germany. It's a topic of political and scientific interest, which can be seen in various legislative procedures (fertilizer law amendment, circular economy policy) and diverse science projects on phosphorus founded in Germany (e.g. Leibniz Science Campus Phosphorus Research Rostock<sup>9</sup> which bundles various P-Projects; BonaRes<sup>10</sup> which funds soil research).

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<sup>8</sup> [http://www.buffertech.dk/wp-content/uploads/2014/10/Experiences-gained-from-2-years-with-mandatory-BSs\\_Kronvang.pdf](http://www.buffertech.dk/wp-content/uploads/2014/10/Experiences-gained-from-2-years-with-mandatory-BSs_Kronvang.pdf)

<sup>9</sup> <https://wissenschaftscampus-rostock.de/home.html>

<sup>10</sup> <https://www.bonares.de/>

Phosphorus in Germany is an important topic but, often, it is not seen as important as nitrate. Indeed, for nitrate, an important point is the infringement procedure<sup>11</sup> of the European Commission against Germany for not fulfilling the Nitrates Directive.

Phosphorus is a relevant topic in Germany because of two points: the environmental effects of phosphorus losses in water bodies (eutrophication) and also the resource scarcity respectively the dependency from phosphorus imports.

## 2.2.2 Phosphorus regulation

In Germany, there is a global law on fertilization: the Fertilizer Act (or Fertilizer Law)<sup>12</sup>, the [\*Düngegesetz\*](#)<sup>13</sup> (DüngG) in German language. It is specified by two regulations (DüV and DüMV). The main principles of the DüngG are the efficient plant nutrition, the safeguarding of soil fertility, the sustainable use of nutrients, in particular the avoidance of nutrient losses in the environment, and the avoidance of dangers for humans, animals and the environment (§ 1 DüngG).

The Ordinance on Fertilizer Quality, the *Düngemittelgesetz* (DüMV), specifies the way that fertilizers are put on the market. The Fertilizer Application Ordinance (FO)<sup>14</sup>, the [\*Düngeverordnung\*](#) (DüV)<sup>15</sup> specifies the Good Agricultural Practice, e.g. the ceilings, the time of fertilizer application, and the minimum allowed distance to water bodies (buffer zones). The FO (DüV) specifies the Fertilizer Act and both implement the Nitrates Directives into German law (Schultz, 2011).

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<sup>11</sup> [http://europa.eu/rapid/press-release\\_IP-16-1453\\_en.htm](http://europa.eu/rapid/press-release_IP-16-1453_en.htm)

<sup>12</sup> [https://www.biorefine.eu/sites/default/files/publication-uploads/biorefine\\_legal\\_framework\\_of\\_recovered\\_phosphorus\\_struvite\\_as\\_fertiliser\\_in\\_north-western\\_europe.pdf](https://www.biorefine.eu/sites/default/files/publication-uploads/biorefine_legal_framework_of_recovered_phosphorus_struvite_as_fertiliser_in_north-western_europe.pdf) (p7)

<sup>13</sup> [https://www.gesetze-im-internet.de/d\\_ngg/](https://www.gesetze-im-internet.de/d_ngg/)

<sup>14</sup> [http://www.gesetze-im-internet.de/d\\_v\\_2017/index.html](http://www.gesetze-im-internet.de/d_v_2017/index.html)

<sup>15</sup> [http://www.umweltrat.de/SharedDocs/Downloads/EN/04\\_Statements/2012\\_2016/2013\\_09\\_Statement\\_Limiting\\_Nutrient\\_Surpluses\\_Effectively.pdf?\\_\\_blob=publicationFile](http://www.umweltrat.de/SharedDocs/Downloads/EN/04_Statements/2012_2016/2013_09_Statement_Limiting_Nutrient_Surpluses_Effectively.pdf?__blob=publicationFile)

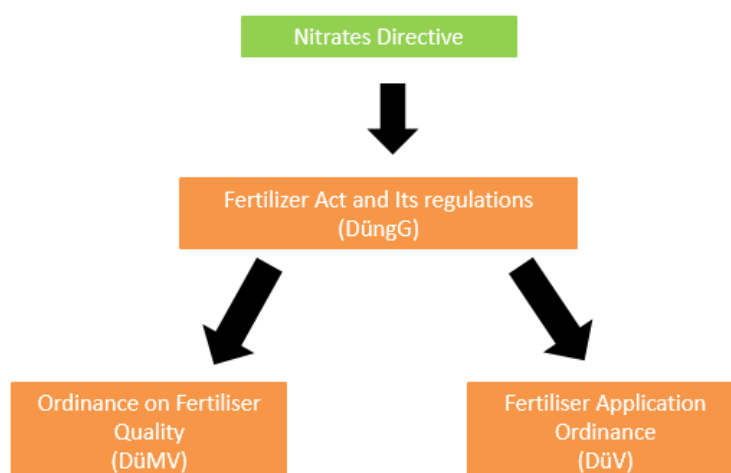


Figure 2. German laws on fertilisation

The FO (DüV) is the most important regulation on nitrates, ammonia and phosphorus losses in agriculture. The FO and the Fertiliser Act have been recently revised, in 2017, in order to fulfil the requirements of the Nitrates Directive. In this context, the Fertilizer law was amended as the introduction of certain measures in the FO required an update of the legal basis.

The FO allows for a nutrient balance surplus for phosphorus. This surplus was reduced from 20 kg P/ha/a to 10 kg P/ha/a for the years after 2018-2023 (6-year-average) (Kuhn, 2017). If the soil has a high P-soil content no surplus is allowed (0 kg P/ha/a).

Besides the nutrient balance limit of 10 kg P/ha/a, the phosphorus application is limited by another rule: if the soil P- content exceeds 20mg P<sub>2</sub>O<sub>5</sub>/100g soil (according to the calcium acetate lactate extraction method), the fertilization has to be aligned with the uptake of the plants. This soil P- content corresponds roughly with the upper limit of the target soil P- content classes of VDLUFA (Association of German Agricultural Analytic and Research Institute). In Germany, there are not any other ceilings for phosphorus besides the two mentioned above, the 20 mg P<sub>2</sub>O<sub>5</sub>/ 100g of soil and the tolerable annual surplus allowed which is 10 kg P/ha/a in a 6-year-average. So there is not an absolute limit for phosphorus in comparison to nitrogen. The application standard for nitrogen animal manure is fixed at 170 kg N/ha in the Nitrates Directive and also in the FO (DüV).

Measures	Fertiliser Ordinance 2007	Fertiliser Ordinance 2017
« Fertilizer planning »	Unspecified	Clearly defined and compulsory
Organic N application – threshold	170 kg N/ha	170 kg N/ha
Organic N application – calculation	Only N from animal manure	N from animal and plant sources (all mineral and organo-mineral sources)

Organic N application – derogation	Up to 230 kg/ha for grassland	<b>Planned, design not known</b>
<b>Nutrient balance – allowed surplus</b>	60 kg N/ha/a (average of 3 years) <b>20 kg P/ha/a (average of 6 years)</b>	50 kg N/ha/a (average of 3 years) (from 2020) <b>10 kg P/ha/a, 0 kg P/ha/a on soils with &gt;20mg P<sub>2</sub>O<sub>5</sub>/100g soil (average of 6 years) (from 2023)</b>
Nutrient balance – calculation	Surface balance	Surface balance approach Stepwise introduction of <b>farm gate balance approach</b>
Blocking period – fixed	Grassland 15/11- 31/01 Arable land 1/11 – 31/01	Grassland 1/11 – 31/01 Arable land from harvesting the main crop until 31/01 ; for solid manure and compost 15/12 - 15/01 (+ exceptions)
Blocking period – after harvest of the main crop	Organic nutrient application restricted to 40 kg Ammonia N or 80 kg total N for catch crops, winter crops, and straw rotting	Total nutrient application restricted to 30 kg/ha Ammonia N and 60 kg/ha total N for catch crops, winter rapeseed, field forage and winter barley following cereals in crop rotation
Minimum distance from surface water for fertilizer application	3 meters 1 meter (if working widths equals spreading widths) 3 meters (steeply sloping)	4 meters 1 meter (if working widths equals spreading widths) 5 meters (steeply sloping)
Additional measures in pollution hot spots (Nitrate in ground- and phosphate in surface waters)	/	The Federal States have to apply at least 3 out of 14 predefined measures in pollution hotspots; more measures optional: - E.g. restriction or prohibition of P fertilization - E.g. extension of blocking periods

Table 4: Main principles of the Fertilisation Ordinance of 2007 and 2017 (Kuhn, 2017)

In addition, two further relevant ordinances are the Sewage Sludge Ordinance (also called the *Abfallklärschlammverordnung* - AbfKlärV) that concerns the phosphorus recovery (Table 6) and the Material Flow Balance Ordinance (also called the *Stoffstrombilanzverordnung* - StoffBilV).

Fertiliser Act (DüngG) – 2009 revised in 2017
<ul style="list-style-type: none"> <li>- Legal basis of the FO (DüV)</li> <li>- Efficient fertilizer/plant nutrition (yield orientation), ensuring soil fertility, sustainable use of nutrients, in particular avoidance of P-losses in the environment, avoid dangers for humans, animals and the environment, implementing EU law (§ 1 DüngG )</li> <li>- Amendment of DüngG and DüV in 2017: purpose extended to secure a resource efficient use of nutrients and to reduce nutrient losses into the environment (§ 1 No. 4 DüngG)</li> <li>- § 3 (2) DüngG: good agricultural practice → specified in DüV</li> <li>- Implement European directives (Nitrates Directive)</li> </ul>
Ordinances
<p style="text-align: center;"><u>Fertiliser Application Ordinance (DüV) revised in 2017</u></p> <ul style="list-style-type: none"> <li>- P fertilisation has to be aligned with nutritional needs of plants and consider the site-specific soil conditions and plant availability of phosphorus (§ 3 (2), § 4 (3) DüV)</li> <li>- Average nutrient surplus for the last 6 years has been halved for phosphorus from 20 kg P<sub>2</sub>O<sub>5</sub>/ha/a to 10 kg P<sub>2</sub>O<sub>5</sub>/ha/a (§ 9 (3) DüV) starting from 2023</li> <li>- The following factors are used to determine the fertiliser requirement: phosphorus requirement of the plant stock under the respective site and cultivation conditions as well as phosphorus quantity available in the soil and nutrient fixation (§ 4 Para. 3 DüV)</li> <li>- § 3 (6) DüV: if P soil content exceeds 20 mg P<sub>2</sub>O<sub>5</sub>/100g soil (CAL-method) → fertilisation has to be aligned with uptake of plants</li> <li>- If harmful changes in water bodies are determined as a result of the application of phosphate-containing fertilizers, the competent authority under local law of federal state may order the farmer in individual cases that only small quantities of phosphate may be applied in deviation from the 20mg P, or prohibit the application of phosphate-containing fertilizers (§ 3 Para. 6 S. 2 DüV).</li> <li>- Soil sampling regarding soil P content every 6 years (§ 4 (4) No. 2 DüV)</li> <li>- No absolute limit for phosphorus fertilisation in contrast to nitrogen (all in all the Fertilizer Ordinance more focusses on nitrogen)</li> </ul>
<p style="text-align: center;"><u>Ordinance on Fertiliser Quality (DüMV)</u></p> <p>Quality assurance of fertilizers → requirements for fertilisers regarding quality standards, labelling, market access and market distribution.</p>

Table 5: German legislation and regulation on fertilisation (Federal Ministry of food and Agriculture, 2013; Kuhn, 2017)

Ordinances
<p><u>Material Flow Balance (StoffBilV) – 2017</u></p> <p>Since 01/01/2018: new legislation for calculation method → material flow analysis</p> <p>Annual Balance Sheet</p>
<p><u>Sewage Sludge (AbfKlärV)</u></p> <p>Obligation for P-recovery, principle of resource efficiency, circular economy + securing the P-supply of soil/plants (use for fertilisation purposes) + quality assurance</p> <p>Obligation for sewage treatment plant operators to recover phosphorus from sewage sludge from 2029 respectively 2032 + extensive ban on the direct sewage sludge application on soils (small municipalities with less than 50.000 inhabitants are excluded).</p>

Table 6: Main principles of the Material Flow Balance and the Sewage Sludge ordinances

### 2.2.3 Policy Actors

Germany is a state composed of 16 federal states (*Bundesländer*). At the national level the Ministry of Environment (*Bundesumweltministerium*) is responsible for environmental policy. Three independent authorities have been established under the supervision of the Ministry: the Federal Environment Agency (UBA), the Nature Conservation Agency (BfN) and the Federal Office for Radiation Protection (BfS).

With regard to fertilization, the UBA is the most important of these three agencies. Its main tasks are to scientifically support federal government, to implement environmental legislation and to inform the public. The UBA is, on the one hand, commissioned by the federal government, especially by the BMU (Ministry of Environment), to conduct research and, on the other hand, has its own research agenda and project setting. Policy is made for the whole German territory.

At the federal state level (or regional level), things are different: each federal state has its own administration for environment, which implements national policy at federal state level. They can adjust the measures set at the federal level by raising the rules according to their context.

At local scale we can find the upper authority (district) and the lower authority (municipality, city).

The fertilizer act and its regulations are enacted at federal level (BMEL – Ministry of Agriculture and BMUB – Ministry of Environment) and then implemented by the regional authorities, responsible under federal state law. This can be the state institutions and offices, but there are differences in the states (e.g. the chambers of agriculture in some federal states or the state office and its branch offices, e.g. in Saxony, or in other federal states the districts, e.g. in Saxony-Anhalt).

The policymakers from the Federal State communicate with farmers about the regulations by publishing some 'Fertilisation Guidelines' (on the website or printed). Besides, farmers are supported by online advisory services and they can also receive personal advice. Thus, the communication comes from websites, fertiliser recommendations, advisory services (online or personally in the offices), information campaigns, especially in areas where countries have issued special programmes in accordance with § 13 DüV (special requirements of the responsible authorities).

## 2.2.4 Compliance with regulation

The control body is different from a state to another. According to the federal states (the authority responsible under the state law), it can be sometimes the State Office (*Landesamt*) and sometimes the Agricultural Chamber. In some States, like in Saxony-Anhalt, the district can even be the control body.

The inspection are mostly onsite inspection from a random sample of farms (the control quotas depending on the federal state → x% of farms must be controlled, e.g. according to Cross Compliance, where one point is the nutrient balance). There is no warning procedure for the farmers, the only thing they know is that they can be controlled. There might be extra controls for conspicuous farms e.g. if the nutrient balance shows abnormalities. Those balance sheets must be prepared annually from 2018 according to material flow balance ordinance.

Compliance with the FO (*DüV*) is mandatory and the farmers that do not follow the requirements of the regulation (not exceed the 10 kg P/ha/a) can be penalised with a fine. The sanctions (Kuhn, 2017) can be found in the FO 2017 in case of any violation of the law.

## 2.2.5 Efficiency

The DüV is still new, it will be examined in few years if it is sufficient, especially with regard to nitrogen.

## 2.2.6 Farmers perception

For the farmers the most important aspects of compliance with the regulation are the financial effects. E.g. if a farmer has too much nutrients from manure he has to treat it and this can be expensive (e.g. if necessary the separation of solid and liquid phase of manure for transport). And in the case of too little phosphorus, the yield losses are relevant for the financial performance of the farm.

For farmers, phosphorus is rather of regional interest, depending on the existence of a problem or not. In Germany, high soil-P-contents contrast with P deficits. On the one hand, especially in the Eastern part of Germany, there are many regions with a low P-content and there the concern is more to ensure that there will be enough phosphorus for crops. On the other hand, in the Northern part of Germany,

especially in Lower Saxony, the high density of animals contributes to a very high soil-P-content (Figure 3) and there the reduction of P losses in water bodies is an important topic for farmers and authorities.

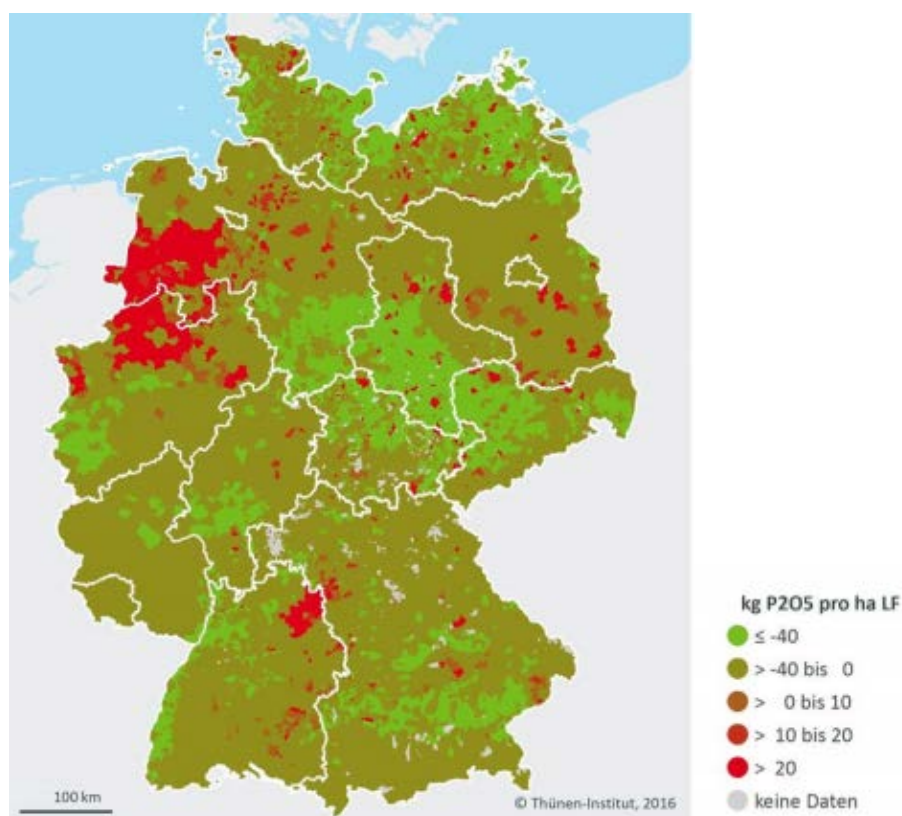


Figure 3. Partial phosphorus balance (animal excretion minus export by crops in kg P2O5/ha) - Reference: Osterburg, Schüler und Klages (2016)  
(Legend: Keine Daten : no data, bis :until)

It is not yet possible to estimate whether new DüV will change this, but since the number of animals will not really be reduced by the DüV, it is quite possible that, even in the next few years, nutrient surpluses will still exist.

## 2.2.7 Other measures

Besides legislation, in Germany the VDLUFA<sup>16</sup> (Association of German Agricultural Analytic and Research Institute) gives recommendations for fertilization. Furthermore there are also actions taken by the Agricultural Chambers or State Offices, e.g. information campaigns, lectures, consulting services.

There is also web portals such as a Saxonian online tool for creating the nutrient balance, which has a direct voucher, as a result, recognised for controls (especially as data is checked directly for plausibility).

<sup>16</sup> Verband Deutscher Landwirtschaftlicher Untersuchungs – und Forschungsanstalten

## 2.2.8 Perspective

The Fertilization Act and the FO (DüV) 2017 are new, they were established last year so for the next years no changes are considered.

The author Till Kuhn mentioned in his paper (Kuhn, 2017): *“In the revision process, policy makers agreed on the stepwise introduction of a balance following the farm gate approach<sup>17</sup> (the mentioned Stoffstrombilanz-Verordnung). A farm gate balance, in contrast to a surface balance, opposes nutrient input via purchased feed, animals and fertilizer to nutrient output via sold products. It is seen as a more transparent and valid methodology as more parameters can be approved by farm accounting data”.*

*“The new balance is not part of the FO but will be defined in a separate directive which is planned to come into force in 2018. From 2018 onwards<sup>18</sup>, farms need to follow the farm gate balance if they have a higher stocking density than 2.5 livestock units (LU) ha<sup>-1</sup> and more than 50 LU units in total or 30 ha agricultural land. Furthermore, farms which import manure from other farms are included. From 2023 onwards, all farms above a certain size are obliged to estimate nutrient surpluses according to the farm gate balance approach”. The farm gate balance is part of the Material Flow Balance (Stoffstrombilanz-Verordnung) that is implemented since 2018.*

## 2.3 Netherlands

### 2.3.1 General questions

In the Netherlands, nutrient pollution is a real concern. Much of this pollution is the result of agricultural fertilisers, which<sup>19</sup> – when used inaccurate or in abundance – can potentially result in polluted ground and surface water. The Netherlands is particularly affected by this issue, as large parts of the country are intensively farmed.

The problem of phosphorus is mostly related to eutrophication: the Netherlands is facing more problems of excess of available animal manure than scarcity problems.

In this country, phosphorus is considered as equally important as nitrogen (from a pollution point of view).

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<sup>17</sup> [http://www.ccb.se/wp-content/uploads/2016/12/12\\_DSchultz\\_Nutrient\\_balances.pdf](http://www.ccb.se/wp-content/uploads/2016/12/12_DSchultz_Nutrient_balances.pdf)

<sup>18</sup> <https://www.bmel.de/DE/Landwirtschaft/Pflanzenbau/Ackerbau/Texte/Stoffstrombilanz.html>

<sup>19</sup> [http://ec.europa.eu/environment/integration/research/newsalert/pdf/nutrient\\_pollution\\_in\\_Dutch\\_streams\\_is\\_falling\\_402na2\\_en.pdf](http://ec.europa.eu/environment/integration/research/newsalert/pdf/nutrient_pollution_in_Dutch_streams_is_falling_402na2_en.pdf)

## 2.3.2 Phosphorus regulation

In the Netherlands, several measures have been established since 1984 to reduce the impact of manure on the environment (Henkens & Van Keulen, 2001). In 1986, the Manure and Fertiliser Act (*Meststoffenwet*) was established and it was followed in 1987 by the Soil Protection Act (*Wet Bodembescherming*) that aims to regulate the production and application of animal manure.

**The Manure and Fertiliser Act** (*Meststoffenwet*) is a national legislation applicable to all Dutch farmers. The Manure and Fertilisers Act contains specific application standards for nitrogen and phosphorus for grassland and arable land. From 2006 those application standards (Table 7 and Table 8) are established according to the soil P content. For grassland, phosphorus ceilings range from 80 to 100 kg P<sub>2</sub>O<sub>5</sub>/ha and for arable land they range from 50 to 75 kg P<sub>2</sub>O<sub>5</sub>/ha according to the soil P content. For the application standard all types of fertilisers are considered, independent whether it is animal manure or chemical fertiliser<sup>20</sup>.

The Dutch Manure and Fertilisers Act is also, from 1996, the Dutch implementation, in part, of the Nitrates Directive<sup>21</sup>. *“In addition, part of the policy on fertilisers has been incorporated in the Soil Protection Act”*. In the Netherlands, several Actions Plans (Van Eerd et al., 2004) have been established as a response to the Nitrates Directive: the First National Action Plan was set up in 1996. The Actions Plans cover a period of 4 years (PBL Netherlands Environmental Assessment Agency, 2017). The Actions Plans of the Nitrates Directive are implemented in the Fertiliser and Manure Act and all Actions Plans are applied to the whole Dutch territory.

Year	Grassland	Maize	Arable Land
1987-1990	250	350	125
1991-1992	250	250	125
1993	200	200	125
1994	200	150	125
1995	150	110	110
1996-1997	135	110	110
1998-1999	120	100	100
2000	85	85	85

Table 7: Application Standards for manure in kg P<sub>2</sub>O<sub>5</sub>/ha for the period 1987- 2000 (LNV, 2001b, 1997, 1993b) (National Institute for Public Health and the Environment, 2012)

<sup>20</sup> <https://www.holanda.es/media/52510/present.%20h.%20smit%20pdf.pdf> and <http://vodninadrze.pmo.cz/download/rocha-critical-review-of-phosphorus-problematic-in-europ.pdf>

<sup>21</sup> <http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-evaluation-of-the-manure-and-fertilisers-act-2016-2779.pdf> (p6)

		3rd Action Plan		4th Action Plan				5th Action Plan				
		2006	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	<b>Grassland</b>											
Phosphorus content in the soil	High	110	100	90	90	85	85	85	80	80	80	80
	Medium	110	100	95	95	95	95	95	90	90	90	90
	Low	110	100	100	100	100	100	100	100	100	100	100
	<b>Arable Land</b>											
Phosphorus content in the soil	High	95	85	75	70	65	55	55	50	50	50	50
	Medium	95	85	80	75	70	65	65	60	60	60	60
	Low	95	85	85	85	85	85	80	75	75	75	75

Table 8: Application Standards for phosphorus according to the soil P content in kg P<sub>2</sub>O<sub>5</sub>/ha (Rijksdienst Voor Ondernemend Nederland, 2018)

In the Netherlands, an important tool at farm level was the MINAS system (Mineral Accounting System) (PBL Netherlands Environmental Assessment Agency, 2017), established in 1998 and considered as the main instrument<sup>22</sup> for the implementation of the Nitrates Directive and as part of the Manure and Fertiliser Act. The aim of MINAS was to regulate nitrogen and phosphorus losses (“mineral losses”). If farmers exceeded a certain MINAS loss standard, depending on the soil and crop type, they had to pay a tax. This system does not exist anymore: it was abandoned in 2006 as it was rejected by the EU court of Justice. As a result, from 2006 application standards for nitrogen and phosphorus were fixed (Henkens & Van Keulen, 2001).

**The Soil Protection Act** contains information on the quantity and the application of manure that can be used. The Decree on the Use of Animal Manure (Besluit Gebruik Meststoffen: BGM<sup>23</sup>) - based on the Soil Protection Act - is the main regulation concerning animal manure. Both the Manure and Fertilisers Act and the Decree on the use of animal manure are legislative measures to implement measure 2<sup>24</sup> (the capacity of storage for livestock manure) and 3 (limitation of land application of fertilizers) of the Nitrates Directive (annexe III).

Dutch legislation and regulations
<b>Manure and Fertiliser Act (1986) – Meststoffenwet</b>
Implement part of the Nitrates Directive
Specifies the point below:

<sup>22</sup> <https://www.oecd.org/env/tools-evaluation/34351715.pdf>

<sup>23</sup> <http://wetten.overheid.nl/BWBR0009066/2017-03-28>

<sup>24</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0676&from=FR>

<ul style="list-style-type: none"> <li>- Spreading calendar<sup>25</sup></li> <li>- Soil Status <sup>26</sup></li> <li>- Strips and slopes <sup>27</sup></li> </ul> <p>It contains specific application standards for nitrogen (total and animal manure) and phosphorus for grassland and arable land</p>
<p align="center"><b>Soil Protection Act (1987) – Wet bodembescherming</b></p>
<p>This Act contains general rules to prevent soil contamination, including regulations on how and when nitrogen and phosphorus can be applied.</p>
<p align="center"><u>Decree on the use of animal manure (Besluit Gebruik Meststoffen)</u></p> <p>Implement part of the Nitrates Directive</p> <p>How to use fertilisers</p>

*Table 9: Dutch legislation and regulation on fertilisation*

Besides the application standard, there are also production ceilings with regard to phosphorus. In the Netherlands it is allowed to produce only 172.9 million kg of phosphate/year at national level, which implies a limitation of the amount of animals to maximize the number of animals. There are production ceilings for pigs, poultry and for dairy cattle (Table 10)<sup>28</sup>.

Type of animal	Million kg of P	Million kg of N
Pigs	39.7	99.1
Poultry	27.4	60.3
Dairy cattle	84.9	281.8

*Table 10: Maximisation of the phosphate production for the livestock sector.*

This production ceilings are part of the conditions of a derogation pursuant to the Nitrates Directive granted to the Netherlands in 2018<sup>29</sup>: “the Netherlands shall monitor the amount of manure produced and shall ensure that manure production at national level both in terms of nitrogen and phosphorus will

<sup>25</sup> <https://www.rvo.nl/sites/default/files/2018/02/Tabel%2012%20Uitrijdperioden%202014-2018.pdf>

<sup>26</sup> <https://www.rvo.nl/onderwerpen/agrarisch-ondernemen/mest-en-grond/gebruiksruimte-berekenen/fosfaatdifferentiatie>

<sup>27</sup> <https://www.rvo.nl/onderwerpen/agrarisch-ondernemen/gemeenschappelijk-landbouwbeleid/gemeenschappelijk-landbouwbeleid/randvoorwaarden/goede-landbouw-en-milieuconditie>

<sup>28</sup> <https://www.rijksoverheid.nl/documenten/rapporten/2017/12/22/zesde-nederlandse-actieprogramma-betreffende-de-nitraatrichtlijn-2018-2021> (page 62, paragraph 5.7.1 Maximizing mestproductie)

<sup>29</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018D0820&from=FR>

*not increase beyond the level of the year 2002 corresponding to 504,4 million kg of nitrogen and 172,9 million kg of phosphate”.*

Thus, in the Netherlands, there are two types of regulation with regards to phosphorus: the application standards and the production ceilings. The application standard and the production ceilings can be found in the Manure and Fertiliser Act and also in the Soil Protection Act.

Moreover, a tool to assess the annual cycle of nutrient for the livestock was established: the ANCA model<sup>30</sup> (Annual Nutrient Cycling Assessment). According to article “*Quantifying the environmental performance of individual dairy farms – the annual nutrient cycling assessment*” (Aarts et al., 2015), ANCA consists in an annual evaluation of the nutrient element as nitrogen and phosphorus of each farms. ANCA is a tool, used at the farm level, which calculates the excretion and the amount of nitrogen and phosphorus that can be spread<sup>31</sup>.

- **Wastewater Reuse:**

Waste water reuse<sup>32</sup> falls within the competence of the Ministry of Environment. In Netherlands the wastewater reuse could be for example used for horticulture.

- **Sludge Spreading :**

Sludge spreading Legislation falls within the Decision on the use of fertilisers (*Besluit Gebruik Meststoffen*), which is implementing the Law on the Protection of the soil. In the way of manure spreading, the Netherlands do not have distinction between nitrates and phosphorus.

### 2.3.3 Policy actors

In the Netherlands there are several actors involved in the water policy. At the national level, the Ministry of Agriculture, Nature and Food Quality, together with the Ministry of Environment, establish the manure policy. Water policy is the competence of the Ministry of Environment.

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<sup>30</sup> <https://www.rijksoverheid.nl/documenten/rapporten/2017/12/22/zesde-nederlandse-actieprogramma-betreffende-de-nitraatrichtlijn-2018-2021>

(see p55 paragraph 5.5.3.1)

<sup>31</sup> <https://www.reussir.fr/lait/actualites/aux-pays-bas-anca-permet-de-gerer-l-exploitation-dans-le-cadre-de-la-directive-nitrates:Z7RTG31X.html>

<sup>32</sup> <https://www.cbs.nl/nl-nl/maatwerk/2018/18/terugwinning-en-hergebruik-bij-rioolwaterzuivering-2016>

At a lower scale, the “National Water Authority” (*Rijkswaterstaat*) is under the supervision of the Ministry<sup>33</sup>. At regional scale, the Provinces (12) supervise the Regional Water Authority (RWA) and coordinate the regional policy.

At the catchment scale, management is done by the RWA.

At the local level the municipalities do the local management.

In the Netherlands there is a tripartite management with the Provinces- the Regional Water Authority and the Municipalities.

## 2.3.4 Compliance with regulation

Manure policy – which includes not only regulation but also communication and other relevant measures - is controlled and enforced by the NVWA<sup>34</sup> (Netherlands Food and Consumer Product Safety Authority) and the RVO.nl<sup>35</sup> (Netherlands Enterprise Agency). The NVWA is an independent agency<sup>36</sup> of the Ministry of Agriculture, Nature and Food Quality. The RVO.nl is part of the Ministry of Economic Affairs and Climate Policy and was previously called the ‘*Dienst Regelingen*’.

Type of regulation farmers should comply with and how they should do could be found on their website. The RVO.nl is responsible for the administrative controls and they also register all type of information on the agricultural farms. They collect data for the Common Agricultural Policy and they collect data with regard to Manure Policy. Those data combined, they have the opportunity to find out whether one farm has complied with the application standards or not in one year.

Besides, the NVWA (Dutch Food and Safety Authority) is responsible for the on-site inspections.

Compliance with regulation is largely monitored. Each year, farmers have to complete a form and send it back to the RVO.nl.

In addition, some private companies have developed manure accountability Information and Communication Technology packages (computer tool). When using these tools a farmer is enabled to know what nutrients are produced on his farm, and what nutrients go out from his farm.

The packages used are controlled beforehand by the RVO.nl to check if they are consistent with the legislation so the farmers can use it for their manure management. And some of those data are also forwarded to the government for the administrative controls.

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<sup>33</sup> <https://www.noordzeeloket.nl/en/management/government/infrastructure-and/>

<sup>34</sup> Nederlandse Voedsel en Waren Autoriteit

<sup>35</sup> Rijksdienst voor Ondernemend Nederland -

<https://www.rijksoverheid.nl/documenten/rapporten/2017/12/22/zesde-nederlandse-actieprogramma-betreffende-de-nitraatrichtlijn-2018-2021> (p18 paragraph 3.2.7) and <https://english.rvo.nl/home/about-rvonl/what-is-rvonl>

<sup>36</sup> <https://english.nvwa.nl/about-us/organisation>

### 2.3.5 Efficiency

The Manure and Fertiliser Act is evaluated once every five years<sup>37,38</sup>. On 30 March 2017 the PBL (*Planbureau voor de Leefomgeving*) Netherlands Environmental Assessment Agency published the results of the '2016 Manure Law Evaluation' on their website<sup>39</sup>.

As mentioned in the evaluation efficiency of the law : « *From 2010 onwards, on average, no statistically significant decrease in summer concentrations of phosphorus in run-off and surface water has been observed in all soil regions. The Manure and Fertilisers Act, however, has been causing decreases in phosphate fertiliser use and particularly phosphate surpluses in the soil – on average, these surpluses in dairy farming were 'zero' in 2015. The WFD targets for 2027 will not be achieved under current policy; the average phosphorus concentrations in surface water exceed the WFD targets by a factor of two to three* ».

The “Landelijk Meetnet effecten Mestbeleid” (LMM) is the national network that measures the effects of manure. It monitors the water quality in the farms.

For the farmers, speaking about the application standard, the first important thing they often mention is that they are afraid about the yield loss if they cannot use enough phosphorus anymore. A yield loss would financially effect their income. Also, farmers mention that they are afraid the soil fertility will decline. There are however a lot of other factors (organic matter, humidity) that should also be considered related to soil fertility.

### 2.3.6 Other measure

In the Netherlands, “*they wanted to have measures that have a positive effect on the surface water but it is complicated because there are indirect and long term relations between P-use on land and the concentration of phosphorus in surface water*”.

There are some voluntary measures that are financed in the Rural Development Plan.

Farmers are very aware of their phosphorus production with the strict regulation on limit in animals. The effects of the use of nutrients on the runoff toward surface water (and groundwater) are to develop<sup>40</sup>. In addition, as of 2014 all farmers are obliged to process their surplus manure.

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<sup>37</sup> <http://www.pbl.nl/en/publications/evaluation-manure-and-fertilisers-act-2016-synthesis-report>

<sup>38</sup> <http://themasites.pbl.nl/evaluatie-meststoffen-wet/>

<sup>39</sup> [www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-evaluation-of-the-manure-and-fertilisers-act-2016-2779.pdf](http://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2017-evaluation-of-the-manure-and-fertilisers-act-2016-2779.pdf)

<sup>40</sup> <https://www.rijksoverheid.nl/documenten/rapporten/2017/12/22/zesde-nederlandse-actieprogramma-betreffende-de-nitraatrichtlijn-2018-2021> (see p60 paragraph 5.6.1)

## 2.3.7 Perspectives

Changes<sup>41</sup> may be set up in the regulation on agricultural phosphorus because “*we are looking on the efficiency of our Manure Policy but we are just only at the beginning on that project so we are not sure what will be the effect of that project*”. Besides, as described in Table 11, a revision of the manure policy system is foreseen.

Soil phosphate class of land parcel	Grassland		Arable land	
	P-AL- indicator value	Phosphate application standard kg P <sub>2</sub> O <sub>5</sub> /ha	Pw- indicator value	Phosphate application standard kg P <sub>2</sub> O <sub>5</sub> /ha
Poor	<16	120 (was 120)	<25	120 (was 120)
Low	16-26	105 (was 100)	25-35	80 (was 75)
Neutral	27-40	95 ( was 90)	36-45	70 (was 60)
Sufficient	41-50	90 (was 90)	46-55	60 (was 60)
High	>50	75 (was 80)	>55	40/45 (was 50)

Table 11: Modifications in the phosphorus application standards in the Netherlands scheduled in 2020

## 2.4 Italy

### 2.4.1 Background

In Italy, “*phosphorus hasn’t been identified as an important issue because the losses have been considered limited*”.

Moreover, in Italy, there isn’t a political awareness to consider phosphorus as a problem, like nitrogen has been. Phosphorus has always been considered « *less important* » than nitrogen, also because it is distributed in smaller quantity than nitrogen.

Oppositely, the Italian respondent mentioned two reasons why phosphorus issue is important, according to him “*because there is the future scarcity of the resource that will create troubles as the increase of the prices with several others consequences*”. The other one is that « *phosphorus is responsible, in*

<sup>41</sup> <https://zoek.officielebekendmakingen.nl/kst-33037-250.html> ('Herbezining mestbeleid', p3)

*part, of the eutrophication of water bodies and this is linked to an excessive and inappropriate use of fertiliser in agriculture ».*

For him, one of the reason of the absence of legislation is that communication between actors (administrative institution and farmers) is complicated. Another reason is that *« the problems are complicated and there are multiple factors with a lot of interactions that could affect the phenomenon ».*

## 2.4.2 Regulation and other measures

In Italy there isn't any legislation for agricultural phosphorus at national scale. At regional scale, Tuscany (study area) didn't implement any legislation on P.

However, at local scale, some actions can be taken. For instance, the area near the Massaciuccoli Lake (Tuscany) is highly eutrophicated and it is inside the regional Park of Migliorano that has its own package of measures. But, even if it is official, it is not mandatory and it is not controlled. These are just suggestions for farmers.

For the respondent, the problem has been partially faced with the aim of having *« less chemical products, for a healthier product »* and not for having less phosphorus released in the environment. It is more related to human health.

They are also trying to face the problem with incentives coming from the Rural Development Plan (RDP) to stimulate farmers to have an environmental friendly behaviour (reduction of fertilisers use, cover crops, and buffer zones).

## 2.4.3 Institutional organisation

In the Italian environmental political organisation, a lot of actors are involved. The State (the Ministry of Environment), at a level below the Regions and then the Provinces and the Municipalities.

In the Massaciuccoli Lake other actors are added as the *Autorita di Bacino* (Catchment Authority) and the *Consorzio di Bonifica e d'Irrigazione* (the Land Reclamation and Irrigation Authority) and also the regional Park.

- Communication

Besides the administrative complication in Italy, communication between actors is difficult. In some regions as the Veneto Region, they are very active and provide information to farmers to help them. In others regions as Tuscany, *“communication is not present”*.

The ISPRA (Istituto Superiore per la Protezione e Ricerca Ambientale) publishes handbook to help farmers to better understand legislation. Until few years ago, there was a regional agency for agriculture that provided a technical assistance for farmers. This agency do not exist anymore and the technical assistance is carried out by union associations.

#### 2.4.4 Perception

There is no consensus concerning the main source of the phosphorus pollution: there is no equation like “*phosphorus in water = phosphorus from agriculture*”.

As the researcher mentioned, “*Farmers are aware of the environmental problem concerning phosphorus issue because there are not many fish left in the lake and because it is no more possible to swim in it*”. “*Although they are aware of the problem they do not agree for their responsibility on it because over the past ten years the level of fertilisation has been considerably reduced*”. And, for them “*as the level of fertilisation has been reduced, the pollution is not only related to their activity. There are a lot of interaction between factors.*”

## 3. Cross analysis

The crossed analysis have been carried out according to the interview guide topics.

### 3.1. Phosphorus issue

Phosphorus is an important issue in all the interviewed countries, even if they have a different approach on the topic. Phosphorus has been identified as an important environmental issue that can lead to water bodies' pollution in Denmark, Germany and Netherlands. Italy is apart because phosphorus hasn't been identified as an environmental issue of political interest, even if there are problems due to eutrophication.

According to the interviewed countries, the importance of phosphorus in relation to nitrogen is not the same: from equally important as nitrogen in the Netherlands, to less important than nitrogen in Germany and in Denmark. However, phosphorus is a growing topic becoming more important in the Danish territory.

In all these countries, phosphorus problems are mostly related to eutrophication caused, in part, by the agricultural phosphorus losses. The scarcity of the resource hasn't been mentioned by the respondent except for Germany but the current problems of pollution mostly explains the regulations that have been established.

### 3.1 Legislation

#### 3.1.1 National regulatory framework

There is no European Directive that regulates agricultural phosphorus use. Four States, Germany, Netherlands, Italy and Denmark, have been interviewed and three have established some national regulations: Germany, Netherlands and Denmark. The case of Italy is apart because there isn't any regulation on agricultural phosphorus at national level.

Moreover, according to the State history on nutrient agricultural pollution, some specific regulations have been foreseen. Three countries have started to manage phosphorus agricultural losses (to reduce the environmental impact of manure) since 1980-1990, including Netherlands and Germany through a general legislation on fertiliser and manure use. It shows that a legislation is present for 30 years.

- The Fertiliser Law (*Düngemittelgesetz*) in Germany (that has been replaced by the Fertiliser Act (*Düngegesetz*) in 2009) and the Manure and Fertiliser Act (*Meststoffenwet*) in the Netherlands are both the most important legislation on fertilisation established in the 1980s, even before the Nitrates Directive was implemented. The Fertiliser Act in Germany is specified by a regulation, the Fertiliser Ordinance (*Düngeverordnung*), which contains the limitation with regards to phosphorus. In 2017, both the Fertiliser Act and the Fertiliser Ordinance has been reviewed in order to fulfil the requirements of the Nitrates Directive.

- In Denmark, the environmental policy linked to the agricultural sector is based on Action Plans which are the NPO (Nitrogen Phosphorus Organic Matter) established in 1985, and the Plan on Aquatic Environment (APAE). The APAE I (1987) and II (1998) were mainly focused on nitrogen and phosphorus from the wastewater treatment. The APAE III, introduced in 2004, focuses more on agricultural phosphorus. In particular, a tax on mineral phosphate for feed (4 DKK/kg mineral phosphate) has been set up to reduce phosphorus discharges, and it still exist nowadays.

Specific phosphorus ceilings have been established in Denmark since 2017, as part of their new phosphorus regulation.

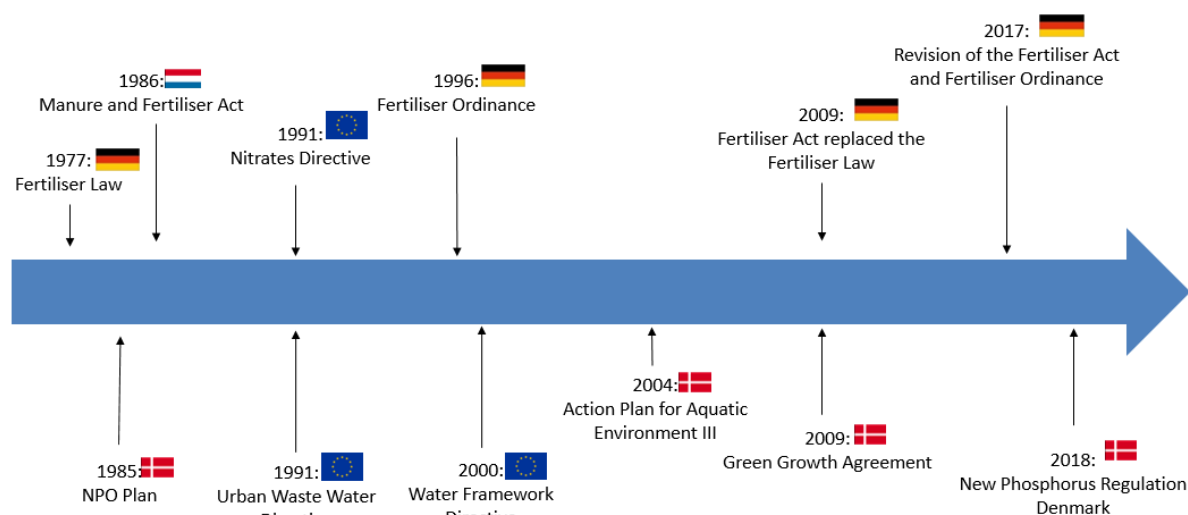


Figure 4: Overview of the different legislations concerning phosphorus use in Germany, Netherlands and Denmark

With regards to the regulation system, there are differences according to the States. In Germany, the nutrient balance has to be respected with an annual tolerable surplus that will be halved from 20 kg/ha to 10 kg/ha from 2023. Both Netherlands and Denmark regulates phosphorus through application standards. But the difference is that the application standards are related to the type of crop (arable land or grassland) for Netherlands and to the manure type for Denmark. In Netherlands there is also the phosphate rights system (quota production) to control and limit the production of animal manure, fixed at 172.9 million kg of phosphate per year at national level.

Some of those measures depend on the soil P content (soil analysis). In Denmark, the phosphorus ceilings allowed can be increased if the soil P content is low (below 4 mg/kg of soil). In the Netherlands, the application standards depend of the phosphorus status in the soil (« high », « medium » or « low »). In Germany, if the soil P content exceeds 20mg P<sub>2</sub>O<sub>5</sub>/100g soil, the fertilization has to be aligned with the plant uptake.

Italy is aside from the three other countries because there isn't any legislation on phosphorus use in agriculture at national level.


Regulation/ Country	Germany	Netherlands	Denmark
Regulation system	Nutrient balance 	Application standard <b>kg P<sub>2</sub>O<sub>5</sub>/ha</b>	Application standard <b>kg P/ha</b>
Ceilings	10 kg P/ha from 2023 (surplus)	Grassland : 80-100 kg P <sub>2</sub> O <sub>5</sub> /ha Arable land : 50-75 kg P <sub>2</sub> O <sub>5</sub> /ha	Manure type : 30-43 kg P/ha
Additional regulatory measures	No surplus allowed if soil P content < 20mg P <sub>2</sub> O <sub>5</sub> /100g	Quota production <b>172,9 million kg of P</b>	Ceilings <u>can be</u> increased if soil P content < 4mg/100 g

Table 12. Type of phosphorus regulation in each country

Some regulations do not apply at national scale but only in a part of the territory. For example, in Germany, in the framework of the revision of the Fertiliser Ordinance, the Federal States have to implement additional measures with regards to the pollution (fourteen measures have been defined). Three measures at least have to be implemented, as for example the restriction or prohibition of phosphorus fertilisation and the extension of the blocking period.

#### *Derogation to the Nitrates Directive and effects on phosphorus*

In the framework of the European Nitrates Directive, the measure on the limitation of land application fixed at 170 kg organic N/ha/year has been implemented in both Denmark (Harmony Rules or Harmoniregler) and Netherlands (Manure and Fertiliser Act or Meststoffenwet).

A derogation can be granted, under certain conditions, concerning this amount of livestock manure that can be applied to the land each year. Those conditions can concern phosphorus. In Denmark, the conditions include a new phosphorus regulation put into force in 2017, and in Netherlands they introduced the system of phosphate quota for the animal manure. In Germany, it is planned to request for derogation at the European Commission, as stated in the FO 17, but detailed terms and linked requirements are not known yet.

Others regulations with regards to phosphorus are possible as the regulation of the sludge use, the reuse of wastewater.

### 3.1.2 Other measures - communication

Besides the mandatory legislation there are some additional measures with regards to phosphorus.

Voluntary measures are also set up in Netherlands and Denmark. Those measures could be supported by a financial assistance. In Denmark, the financial support comes from the Ministry in the case of establishing (mini) phosphorus wetlands, and in the Netherlands some subsidies comes directly from the Rural Development Plan. Suggestions are given to the farmers locally in Italy on fertilisation as in the region of Massaciuccoli Lake affected by eutrophication problems.

Communication between actors is also an important point. Different means are used to facilitate the communication between farmers and institutions. Communication is established through guidelines, information campaigns or online information in three out of four countries. Both Germany and Denmark have mentioned that there is a communication directly with farmers.

The use of different ways to communicate with farmers shows that efforts are made to ensure a coordination between actors. The bodies in charge of the communication are different depending on the country.

**In Denmark**, The Danish Agriculture Agency, supervised by the Ministry, publishes guidelines for farmers and the SEGES guides farmers on how to fertilize. The Danish Environmental Protection Agency, supervised by the Ministry, also participates to the communication with farmers.

**In Germany**, The VDLUFA is a German association that gives recommendations for the fertilisation. The policymakers from the Federal State also help farmers by publishing some “Fertilisation Guidelines”. Both in Germany and Denmark, communication is mainly done through the publication of guidelines on fertilisation.

**In Netherlands** private companies have developed Information Communication Technologies packages but the RVO.nl also communicate through its website with farmers.

All States communicate with farmers about legislation with the aim to help them and to simplify compliance with the law.

## 3.2 Political Actors

### 3.2.1 Institutional organisation with regards to the agricultural phosphorus regulation

Each countries has its own political organisation with regards to the agricultural diffuse pollution of water bodies. As showed in the Table 13, multiple actors are involved on this topic. Two countries out of four countries have, besides the Ministry of Environment, supervising agencies that manages environmental issues (Denmark and Germany).

Level/Country	Denmark	Germany	Netherlands
<b>National</b>	<b>The Ministry of Environment and its 4 agencies :</b> <ul style="list-style-type: none"> <li>- The Danish Agriculture Agency</li> <li>- The Danish Environmental Protection Agency</li> <li>- The Danish Veterinary and Food Administration</li> <li>- The Danish Nature Agency</li> </ul>	<b>The Ministry of Environment</b> is responsible of the environmental policy and supervise 3 <b>agencies</b> : <ul style="list-style-type: none"> <li>- UBA (Federal Agency for Environment)</li> <li>- BfN (Federal Agency for Nature Conservation)</li> <li>- BfS (Federal Office for Radiation Protection)</li> </ul>	<b>The Ministry of Agriculture, Nature and Food Quality and the Ministry of Environment</b> <ul style="list-style-type: none"> <li>- National Water Authority</li> </ul>
« Regional »	/	Länd	Provinces
<b>Local</b>	Municipalities	Municipalities/ District	Regional Water Authority (watershed level)  Municipalities

Table 13. Political Organisation of each States with regards to the agricultural phosphorus regulation

### 3.2.2 Control Body

Inspections on fertilisation are done to verify the compliance with regulation (European or national). Inspection are present in the 3 countries which have a legislation. Both administrative and on-site inspections are carried out in Denmark, Netherlands and Germany even if in Germany controls are mostly on-site controls.

Controls are shared between two types of structures, one responsible for the administrative part as the Danish Agriculture Agency in Denmark and the RVO.nl (Netherlands Enterprise Agency) in Netherlands, and the other for the on-site inspection, as the municipalities in Denmark and the NVWA (Netherlands Food and Consumer Product Safety Authority) in Netherlands.

In Germany the control body is different according to the federal State.

Regarding those controls, the compliance is mandatory and if not followed, sanctions can be set up.

### 3.3 Perception

In the different interviews, the respondents have underlined an important point: generally, farmers are aware of the environmental issue on phosphorus. This can be explained by the “good communication”: according to the respondents, the communication between actors, as political and farmers, is really important and developed as in Germany, Netherlands and Denmark.

Moreover, the issue can be more or less important according to the geographical interest. In Germany, for the phosphorus issue the relevance is much more important in the northern part, where the soil P

content is high, than the eastern part. In Italy, this question is of local interest (Massaciuccoli Lake) in Tuscany.

### 3.4 Perspective

A lot of new elements have been done on fertilisation legislation in the States as the review of the current law or the set-up of a new legislation. The recent evolution will still continue to move forward with some interesting approach as in Germany with the farm gate approach (a balance that will be focused on the farm scale and not the parcel scale as it was previously) put into force since 2018. Also, in Denmark, a phosphorus project have been set up, by the Ministry of Environment and Food, to evaluate the phosphorus ceilings, to map phosphorus and also to examine the different ways that phosphorus is transported.

The recent implementation of the new regulation in the interviewed countries do not allow us to have real feedbacks on the efficiency of those regulations. Thus, for Denmark, Germany and the Netherlands, it would be interesting to follow the first assessments of those regulations in the coming years.

## 4. Conclusion

The aim of our study was to better understand how several European countries regulate the use of agricultural phosphorus. To answer these questions, a bibliographic analysis on the agricultural phosphorus regulation was carried out, supplemented by interviews conducted in four European Member states: Germany, the Netherlands, Denmark and Italy. The result is an overview of the regulatory situation of these countries, with some elements on the perception of these regulations by the different stakeholders.

The interviews showed that the regulatory situation is very heterogeneous in these four countries. A national regulation on agricultural phosphorus exists in Germany, the Netherlands and in Denmark, whereas this is not the case for Italy. In the case of Italy, some regulations exist at regional level, but it is not the usual case.

For countries having a national regulation, different measures can be used to limit the risks of pollution: phosphorus ceilings, maximum surplus (according to the nutrient balance), national quotas for organic phosphorus production...

Even if fertilisation is regulated for many years, focus was mainly on Nitrogen. In recent years, phosphorus in agriculture is also becoming more and more important in different regulations. Proof of this is a recent evolution of the regulation on phosphorus in some countries: revision of the regulation in force in Germany, new phosphorus regulation in Denmark. So, it would be interesting to follow the first assessment of these new regulations in the years to come.

This work also showed that phosphorus regulations are mostly linked to eutrophication problems in the interviewed countries, whereas scarcity was not mentioned much.

To conclude, it could also be interesting to have an overview of the situation in non-European countries, since agricultural phosphorus is a global scale issue.

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## 6. Annexes

### 6.1 List of people contacted

Thanks to those people who participated to this study.

Pays	Noms des experts	Organisme	Fonctions
Denmark	Line Block Hansen	Aarhus University	PhD researcher
Denmark	Christina Paulin Wright	The Danish Agricultural Agency	
Denmark	Karin Peters	Ministry of Environment and Food of Denmark	
Netherlands	Sandra van Winden	Ministry of Agriculture, Nature and Food Quality	Policy officer
Germany	Béatrice Garske	Research Unit Sustainability and Climate Policy · Leipzig	Researcher
Italy	Nicola Silvestri	Universita di Pisa	Researcher

## 6.2 Interview guide

### 6.2.1 Background and general questions

- Background

Has the phosphorus been identified as a major environmental issue in your country?

What is the level of importance compared to others topics?

Is the agricultural phosphorus issue linked to a matter of scarcity of the resource and/or eutrophication?

- Agricultural phosphorus regulation

-Do you have a specific regulation for agricultural phosphorus in your country? If so, what is its (or are their) name and its (or their) main principles? If not, why?

- Existence of ceilings: by crop type? by fertilisation type ?
- Geographical level of legislation (national or local) : related to a territory or national issue for example
- Distinction between organic or mineral fertilizer?
- Wastewater reuse (name of the legislation, if installed, and how)?
- If you have a specific exemption (derogation) concerning the Nitrates Directive (limit of 170 kg N per hectare per year from livestock manure): measures on phosphorus in your request?
- Sludge spreading (name of the legislation, if installed, and how)?

### 6.2.2 Implementation modalities (of the regulation)

-Regarding the implementation of the regulation, who are the main policy actors involved (governance)?

-How do you communicate with farmers about regulation (type of instruments/ tools: information campaign, posters, video online, publication)?

### 6.2.3 Compliance with regulation (Information System)

- Monitoring structure

In your country, which structure(s) carries out the inspection (in France for example the environmental police division)? What are their (its) name?

- Control implementation and available means

How do these structures carry out the inspection (field verification, online information system)?

On which specific point of the legislation are the controls carried out?

- Farmers warning procedure about the controls?
- Type of possible sanctions?
- Other means of verification for the compliance with legislation

## 6.2.4 Efficiency

Do you have a system for assessing the efficiency of your regulation? If not, why so, what results did you get?

According to you, what are the major incentives and the main obstacles about the implementation on agricultural phosphorus regulation in your country?

## 6.2.5 Acceptability/ Farmers perception on regulation

In your country, how do farmers receive the measures (for example: financial effect, increase of the working time, yield loss)?

## 6.2.6 Other measures

In your country, do you have measures in addition to the legislation (as financial incentive, dialogue, training courses, awareness raising of people involved)?

Are the farmers aware of the agricultural phosphorus issue (in particular, do they implement measure(s) beyond legislation)?

## 6.2.7 Perspective

In general terms, are changes in the regulation or in measure(s) set up on agricultural phosphorus planned in your country?



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