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HOW CAN REGULATION PROMOTE EFFICIENT NUTRIENT USE IN EU?

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Abstract

The purpose of the INEMAD project is to look at management strategies to improve the utilisation of nutrients in agriculture in Europe. This paper looks closer at the nutrient policies in selected EU countries in order to find policies, which has shown to improve nutrient efficiency. High livestock intensity is found in the Flemish region in Belgium, many parts of The Netherlands and parts of France (Britany). The challenges are to combine the interest in high livestock production without having to high environmental impacts. The high livestock intensity has led to higher transport and/or processing costs (Belgium and The Netherlands). The additional costs for West-Flemish farmers can be 10-20 € per ton of excess slurry, which is much higher than the costs required in e.g. Denmark (2-5 € per ton). One would have expected that the high costs would have reduced the livestock density over time in the selected regions, but this has not happened. On the other hand, these regions still struggle to meet the environmental targets as the effect of the regulation takes longer than expected. The policies have been tightened over the years, but it has been difficult to implement measures which are sufficient efficient. Another approach chosen by Denmark has been to use less than economic optimal norms and to require balance between livestock production and area for application of manure. This has been successful in term of environmental impact but has also been rather costly for the farmers. The findings suggest that direct livestock production quotas and voluntary systems have been less efficient.

Keywords: Regulation, livestock intensity, control, environmental impact

1. Introduction

The Purpose of INEMAD (Improved Nutrient and Energy Management through Anaerobic Digestion) project is to improve nutrient efficiency. European agriculture is becoming more and more specialised and this has increased the need for external inputs and it has increased the environmental damage. Indeed, at this moment we experience a paradoxical situation where crop production has a need for fertiliser while livestock has an excess of nutrients.

The leading principle of INEMAD is that processing can help to restore the nutrient cycle and decrease the energy use. Processing refers to the use of animal manure to produce new types of fertilizer including digestate.

Nutrient policies are very different in the participating countries, despite the same EU regulatory framework (The Nitrate Directive and the water Framework Directive) and so the purpose of this article is to give a short comparison of the policies implemented in the different countries. The focus is on the nutrient efficiency linked to manure and livestock regulation looking at both the economic and environmental impacts. The selected countries and regions are: Denmark, Netherlands, Germany, Belgium (Flanders) and France. Finally, the report contains some overall policy recommendation.

2. Denmark

2.1. Denmark

The manure production is concentrated in the western part of the country, but the livestock intensity is not as high as e.g. in Flanders and The Netherlands (under 1 Livestock unit per ha). The regulation on harmony between area and livestock production has meant that farmers need to own area or make agreements for slurry to be redistributed nearby. The implication is that the livestock intensity has not been higher than 1.2 LSU/ha in any part of the country (municipality level) (equal to 120 kg N/ha or 30-35 kg P/ha from livestock manure when evenly distributed). A total of 3% of all slurry is separated.

There are high standards for utilization of N in animal manure (75% for pigs and 70% for dairy cows). This level is higher than in most other European countries. This has reduced the purchase of N from mineral fertilizer substantially over time and created a push for technologies which utilize N in animal manure better (e.g. acidification). This has meant that the average application of mineral fertilizer is down to 75 kg N/ha despite the manure application is under 100 kg N/ha ab storage. The total application is controlled via the fertilizer accounts (Dalgaard et al., 2014).

The binding N-norms are for each field based on the crops, soil type and use of irrigation was implemented in 1987, with binding limits in 1991 (Mikkelsen et al, 2009 and Dalgaard et al., 2014). The amount of mineral N bought should not exceed N-norm minus N from manure. Farmers exceeding the application are fined and so relative few farmers exceed the N-norm. The suboptimal N-norms were introduced in 1998 and the current N-norms are 15% under the economic optimum. This leads to a high value of N if the farmer can utilize it better than the standard. The reduced norms have decreased the N-leaching significantly, but have also been relative costly for farmers in terms of lower yields and lower protein content. The most effective measures in Denmark have been command and control measures and not measures based on voluntary actions.

As shown in figure 1, the policies have reduced N-surplus to under 100 kg N/ha and reduced N-leaching to the root zone by 50% from the mid 1980'ties until today. The ammonia emission has been reduced by 40% from 1990 until today. (Jacobsen, 2012).

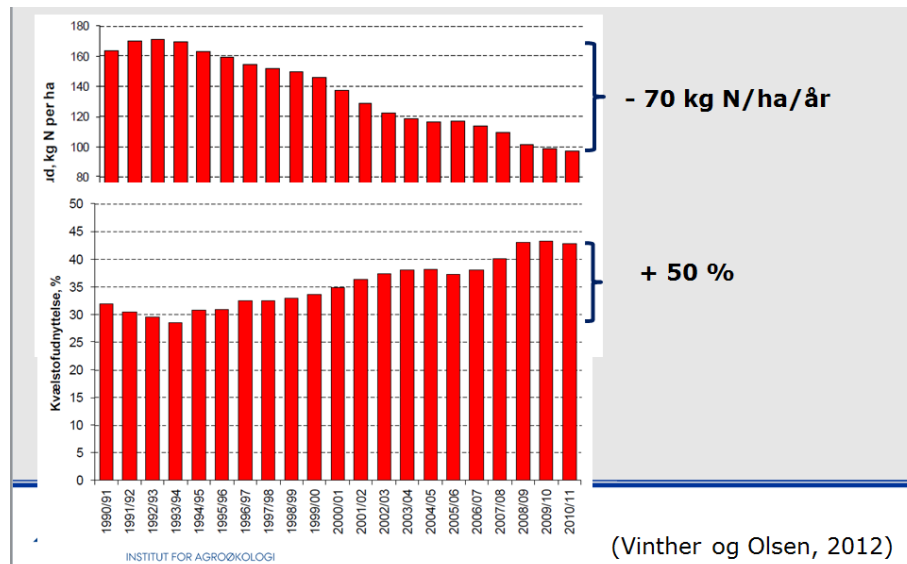


Figure 1. N-surplus (kg N/ha) and N-efficiency (N output from the farm/ N input to the farm) in Denmark 1990 – 2010 Source: Vinther og Olsen, 2012.

There is no transportation of animal manure across borders so it is the domestic transport (< 10 km) which is the most important. The Danish farmers do not seem to have problems with determination of the nutrient content as the results of the laboratory reports are used both by exporting and importing farmers in their fertilizer accounts.

2.2. The Netherlands

Dutch farming is very intensive and so the authorities have been trying to regulate the environmental impact of farming, while at the same time trying to maintain a high livestock production. The highest livestock intensity is found in the eastern and the south east part of the Netherlands (sandy soils). The political approach and the intervention of the farming lobby have meant that the effect of both the legislation has been slower than first expected. The policies have included a reduction in the number of pigs of more than 10% in 1998 and 2002 (limited production rights), but the nutrient production from livestock has increased from 2004 to 2012. The regulation related to production rights have reduced the numbers, but not as much as expected at the outset. The manure production level is around 300 kg N/ha or over 120 kg phosphate/ha (=53 kg Phosphorus per ha) from animal manure alone. The high intensity has meant that for many years a large need exists for redistribution of manure and this has meant that farmers are more eager to find “alternative” solutions. This has meant that some farmers pretended to export manure to the northern part of the Netherlands while they in fact applied the manure on their own fields in the livestock intensive area in the south (Jacobsen, 2001)

Application standards were introduced in 2006 and they are lowered several times for both N and P. Many dairy farms use the derogation (covering 45% of the total agricultural area (Grinsvan et al., 2012) which allows application of 250 kg N/ha from manure. The derogation will from 2014 allow only 230 kg N/ha and in the most sandy regions with many pigs the application rate is under the economic optimum as is the case in Denmark. Of the total manure production (around 70 million tons) approximately 26% is transported to other farms, 3% is exported to other countries and 3% is processed. Without the derogation a much larger share of the manure would need to be transported and exported to other regions and countries as cattle slurry constitute over 80% of the total manure-N. The focus in the regulation has mainly been on P as the limiting factor, where the focus in e.g. Denmark has been on N.

Due to cases of fraud the Dutch system is now based on elaborate and costly administrative procedures including GPS on lorries, regulated weighing and sampling. The majority of pig and cattle manure is exported to Belgium, Germany is the largest buyer of poultry manure and France is the largest buyer of mixed manure. A total of 2.35 million tons manure was exported in 2012. The export to Belgium and France is increasing, whereas the export to Germany is on the decline, but still constitutes more than half of the total export. Increased effort has been made to ensure exchange of data between the countries and especially Germany has focused on this.

Low-tech manure processing costs around 2-5 € per ton (pasteurization and separation), whereas the expensive options cost 15-20 € per ton and they include: Drying/pelleting, evaporation and thin fraction treatment. Chicken manure can also be burned, but the costs are not included. Processing is often more expensive than long distance transport. Transport costs vary from 5-10 €/ton neighbor exchange or via intermediate 10-15 €/ton or export 20-25 €/ton. The high costs increase the production costs, but despite this the production intensity has been maintained (Grinsvan et al. 2010 Willems et al, 2015). In recent years due to stricter application norms has led to a reduction in the amount of nutrient applied in the Netherlands. Today 111 kg N/ha is applied as mineral fertilizer in the Netherlands. As a whole it is a paradox that The Netherlands use so much mineral fertilizer when the production of nutrients from manure exceeds the application requirements. The overall N-surplus has been reduced and is in 2010 down to 1/3 of the level in 1985 so large reductions have been made, but the surplus levels are still higher than in most other European Countries.

There were about 80 manure processing facilities in the Netherlands in June 2013, and this number is likely to increase as farmers will be obliged to process an increasing share of their manure production (up to

50% of their manure in 2015 depending on the region). The processing consists mainly of separation, pasteurization, production of NK fertilizers and nitrification/acidification as well as drying and pelleting.

Table 1. N-norms (kg effective N per ha) for selected crops in Denmark, Holland and Flanders, 2009.

		DENMARK 1)	Netherlands	Flanders
		Kg effective N per ha		
Barley		112-128	80	205-235
Wheat	Feeding	146-174	160-220	205-235
Grass	Grazing and cut	171-282	250-310	248-290
	Cut	231-342	300-350	280-310
Maize		140-165	150-185	205-210
Potatoes	Eating	135-155	245-250	205-235
	Starch	170-190	230	

¹⁾N-norms from DK 2009/2010.

Table 2. Standard utilisation norm for N in slurry. Percent of total N.

	Denmark	Germany	The Netherlands	Flanders
Pig slurry	75	60	60-65	60
Cattle slurry	70	50	60	60

Note: Only Denmark has direct control with total N-application where the expected N- utilization influences how much N from mineral fertilizer can be bought. For the other countries it is an assumed level of utilization.

It is the intention that the regulation should contribute to an improved resource efficiency and closure of the feed-manure cycle in North West Europe. In 2010 the Netherlands imported about 130 million kg P2O5 via feed (CBS-statline). About 90 million kg P2O5 is coming from EU-member states. Germany and France are the most important countries (about 90% of the volume = about 70mkg P2O5). This amount is two to three times the amount of P2O5 currently exported to these countries by manure. By the required manure processing the export of P2O5 to these countries will increase and the feed-manure cycle will improve, but it is relatively costly.

2.3. Belgium

Belgium consists of two very different regions. In Flanders the focus is on high livestock production trying to deal with the environmental impacts afterwards, following the approach adopted in The

Netherlands. In Wallonia the livestock intensity is much lower and they do not allow import of nutrients (manure or organic fertilizers) since 2003. As a result the livestock production and the environmental problems are much lower in Wallonia than in Flanders. The expansion of the Walloon livestock was blocked since 2003. The livestock intensity in Flanders is around 200 kg total manure N/ha, but in some locations over 340 total manure N/ha.

The first Flemish manure action plan in the 1990's has tried to reduce the manure production and ensure more transportation from surplus regions to deficit regions, but also that manure processing should be able to deal with the problems without transferring the problem to soil or water. Over the years, more stringent manure action plans have been implemented, in 2015 the fifth Flemish manure action plan will be designed.

There are limits on the total N and manure N applied per Ha. The farmer in Flanders has to work with either the "total N" system or the "effective N" system. The total N-limit of 350 kg N/ha applied for grassland can be 170 kg total N from manure and 180 kg N from mineral fertilizer or organic fertilizer without manure. In terms of effective N the limit is 235 kg N for grassland which could be 170 kg N manure (=100 kg N active) and 135 kg N mineral fertilizer. The recommended application rates for other crops are lower.

In general the allowed application is higher in Belgium than in some other countries and the expected utilization of N in manure is lower which seems to be leading to a higher than needed use of mineral fertilizer and high N-losses to the environment.

In Belgium the N-application is also linked to soil sampling and N-min measurements in the soil, which gives a direct effect, but the uncertainty related to the measuring can be a problem. The effect for the farmer is that if the N-min values are above a given value he will be forced to reduce fertilizers and he will be forced to keep a fertilizer register and to increase sampling until the analyses are below the norms. The problem might be that the allowed threshold is too high to ensure good water quality.

In 2011 71.1 million kg N and 2.5 million kg P (chemical fertilizer) were applied on 613.805 ha arable land, which is equivalent to 118 kg N and 4 kg P per ha from mineral fertilizer despite the high livestock concentration (based on FADN data). The numbers above are much higher than the numbers based on the Flemish Manure bank.

Of the total manure production it is estimated in 2013 that 80% of the raw manure is applied on area in Flanders (62% on own farm and 18% on other farms). Out of the 20% of the manure which is processed it is assumed that 12% is exported and the rest is either applied on fields in Belgium or changed to N₂. The export is roughly 22 million Kg N of which 8 million Kg N is direct export of manure which is not processed.

Treatment of liquid manure cost around 18 -21 € per ton and the processing and heating of the solid fraction after separation costs is around 25 € per ton. Application of manure is 5-8 € per ton. With an average livestock density of 3 LSU = 60 tonne slurry per ha the additional cost of a livestock intensity above balance (assuming 1 LSU/ha = balance) could be costing as much as 720 € per ha (40 tonne/ha * 18 €/ton) in the worst case where all excess manure is exported, but this is not the average case. Due to these costs Flanders farmers need to earn more than other farmers. The challenge of meeting with manure regulation has been manure processing: more than 118 process installations are processing more than 17 % of the manure production.

Although the analysis results of the groundwater are improving, the legislation needs to be stricter in order to achieve the EU long term goals. The discussions in relation to the regulation in Flanders seem to indicate that the previous loopholes have been used by the farmers to increase production and the focus on reducing environmental impact has been limited. The need to increase production has high priority and so the N-application levels have been quite high. The high transportation costs and the regulation have only led to limited decrease in the livestock production.

2.4. Germany

The livestock intensity is the highest in the North West of the country (over 2 LSU/ha or 200 kg N/ha). These are the regions which boarder to The Netherlands and import manure from The Netherlands. This could indicate that the nutrient applications here are very high. These regions have the highest N-surplus in Germany (fields only) of over 70 kg N/ha. Application of manure is normally 170 kg N/ha, but can be as high as 230 kg N/ha on grassland (used by very few). Since 2014 a special case authorisation for 230 kg N/ha is no longer possible.

The total N-application is not directly based on obligatory N-norms, but recommendations. The N-demand is calculated based on controls of N content in spring. Every German farmer submits an account over the field N-surplus at the end of the year. The focus of the N surplus calculated at farm level is the loss to the aquatic environment and, therefore, does not include ammonia emission. The starting point for livestock manure is the production of manure in the barn, which is then corrected for gaseous losses in the chain until it reaches the plants.

N surplus (field) in Germany is calculated as follows:

- + N from commercial fertilizer
- + N from Manure (quantity of animals * utilization requirement * N content per animal after losses in stables, storage and during application)
- + N from other organic material
- + N fixation
- N Harvested (selling crops and forage)
- N ammonia losses during mechanical engineering

= N field surplus (kg N/ha)

There is a large uncertainty regarding the calculations and especially the yields (standard or own guess) which is why the Farm balance according to the German regulation authorities' can underestimate the N-losses by 30 kg N/ha. There is also a large uncertainty especially regarding forage production (grass and maize). Digestate products have not been included in the calculation but they will be included in the future.

Analyses of the N-surpluses indicate that 20-30% of all farms exceed the 60 kg N per ha limit. There is no direct sanction if N surplus at the field level is higher the desired level. The major sanction seems to be that farms in very vulnerable areas are not allowed to expand their production if the surplus is above 60 kg N/ha.

Slurry is mainly transported in liquid form and so the cost vary with the distance. The digestate products are sometimes treated which costs around 8-15 € per ton. Germany has some problems in achieving the target in the WFD and the EU Commission is in relation to the Nitrate Directive likely to require that Germany tighten the regulation and reduce N-losses.

2.5. France

The livestock intensity is largest in the Great West, which include Brittany. The load from animal manure here is over 200 kg N per ha. The North West of France also receives manure (dry fraction and slurry) from Belgium. Nitrogen application has been based on a code of good practice which is mandatory in NVZ zones. France has zones of additional attention (ZAC). The limit in these zones was 210 kg manure N/ha but it has been reduced to 170 kg N/ha in recent years. In each region N- balances were made but the method allowed for many loopholes (Le Goffe, 2013). It is concluded that voluntary measures have not been very efficient as

it has been observed in other countries, education alone is not effective when optimal environmental standards imply diminished profits for producers, even when they understand the relationship between their practices and water quality.

It seems that the good intentions were not fulfilled with the measures used. The control side could be improved and this is mentioned in several reports from 2000-2010 by the Ministries for Agriculture and Ecology. Despite increased inspections since 2005, administrative and criminal sanctions remain rare and some argue that the enforcement agencies often neglect to follow up (Le Goffe, 2013). New regulation from 2011 has been based on balanced fertilizer system which is based on voluntary systems and specialist setting up application advice. The measures were chiefly co-managed by the French government and the agricultural industry but the system seems unlikely to reduce the N-application significantly as there is no cap on the application.

3. Conclusion

There is politically an interest in increase production in some regions and this has led to a very high livestock intensity (Brittany, Flanders and South East Netherlands). If the regulation is able to handle both the N-application level as well as the ammonia emission this might, not in itself, give higher environmental problems. However, the analysis indicates that it does require well designed and stringent regulation to ensure that high livestock intensity does not result in high nutrient losses to the environment. The reasons seem to be that high livestock production is promoted to encourage activity and income and so it is difficult to implement the required regulation in those regions afterwards. The effect is, therefore, a higher N-application than should have been the case, more site-specific ammonia emissions (accumulated effect despite per animal reductions) and more avoidance of the regulation through avoiding measures as the cost of long distance manure transport is very high. Some of these problems could have been avoided through a limit on the total livestock intensity as is the case in Wallonia and Denmark. This can, on the other hand, led to farmers moving to other countries to start farming in e.g. Poland.

The side effect of high livestock intensity is large costs linked to either transport or processing or both. The analysis shows that the costs related to transport and processing are very high and so it is a surprise that the farm profits can be maintained in those regions. This would indicate that the cluster gains of similar farms in the same area are also quite large. Otherwise, the costs related to transport and processing would make it profitable to move to other regions. There are no indications that land prices are low in the livestock intensive areas.

The analyses show that trying to avoid the environmental problems requires control both with the total N application (e.g. Denmark) as well as the ammonia emission (NL, Belgium and Denmark). The question could be what are the overall societal costs of following a low livestock intensity policy (as Wallonia), as opposed to a high livestock intensity policy in some other regions.

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