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Economic and regulatory instruments to control nitrogen pressure

P. Le Goffe[1†] and C. Donnars[2]

[1]*Agrocampus Ouest, Research Unit, 1303, F-35042 Rennes, France;* [2]*INRA, DEPE, F-75338 Paris, France*

This article examines how the concerns of economic efficiency and of redistribution can be integrated into the design of the policies that aim to control the nitrogen flows. Generally speaking, the economists recommend to determine the degree of pollution and to arbitrate between the gains and the transaction costs associated to the implementation of the policy. Regarding instruments, the reduction of the diffuse nitrogen pollution needs a quantitative or economic instrument owing to the difficulty of valuing the environmental efforts of the producers on markets. Unlike for pesticides, the quota is here preferred to the tax, in particular in the case of fertilisers. The polluter-payer principle should be applied to the risks of accidental pollution on livestock farms. Results of a long process under the European Commission pressure, the policies of EU members in Northern Europe are more in line with the economic prescriptions than those of France. Recent evolutions go nevertheless forward, even if penalties for enforcing the practices standards are always missing.

Keywords: diffuse pollutions, nitrate, livestock farm, environment, policy

Introduction

Environment policy instruments are generally placed in two major categories: quantitative or regulatory instruments (quotas, standards, obligations or prohibitions, etc.) and economic incentives (taxes, subsidies, penalties). Regulatory instruments are currently preferred for French policies concerning the control of pollutions of livestock farming systems. However, issues remain on the definition of standards believed to limit diffuse pollutions and also on the verification that farmers are adhering to the rules (see Langlais *et al.*, 2014, in this issue). Economists accord little credibility to voluntary approaches and collective cooperation of producers to help the environment. In order for these approaches to be effective, producers must realise savings or behave as genuine 'altruists' and that the environment is considered as the collective production factor of a marketable product. These are conditions that rarely exist.

Again for economists, the choice of a political instrument ideally responds to the search for the highest possible collective value, or else the lowest cost in order to reach a given environmental objective. This theoretical context has several consequences. First, the value of environmental damage is estimated in most cases with a very large margin of error. As a result, environment policies preferentially aim at quantitative goals negotiated politically (such as 'Factor four' for greenhouse gases in Europe or the 'good ecological state of aquatic environments' in the Water Framework Directive).

Second, and again ideally, political tools should be differentiated according to each agricultural and environmental context. A literature search has shown that economic efficacy increases by distinguishing policies according to spatial factors (by reducing pollution more in those regions where the greatest benefits can be obtained) and depending on producers (devoting more efforts to those with the lowest reduction costs). Political instruments thus delimit environmental zonings and categories of farms. Although considerations of economic efficacy are crucial for the choice of instruments, arbitration must also take into account social justice and balanced land use planning.

Finally, the question is posed on the choice of the least costly environmental indicators to use and verify, without losing sight of the state of the environment. As a result, the compromise is located between easily or variables measured criteria. Easily measured criteria, inputs or products, for example, are only slightly correlated with damage from pollution when variables criteria; nitrogen excesses per hectare, for example, are better correlated with polluting emissions, but that result in higher information and implementation costs for both the government and farmers. (Shortle *et al.*, 1998; Horan, 2001; Cochard *et al.*, 2009)

Taxes

In general, economic theory attributes greater effectiveness to incentives than to regulation, since the cost for society is lower and their flexibility is higher when faced with changes in economic or technological conditions. This potentially enables producers to adapt, whereas regulations are by definition inflexible. When taxes or eco-conditionality are in question, these incentives are a means of implementing the

† E-mail: philippe.legoffe@agrocampus-ouest.fr

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principle of responsibility. Systematic taxation of nitrogen inputs, for example (fertiliser, animal feed), is easy to put into place but the level of taxation must be high enough to effectively reduce nitrogen consumption. Examples of this taxation in several countries show that it was used more as income's source than as a tool to reduce the use of nitrogen and most often was abandoned. In general, the problem of taxing inputs is that it does not target the major cause of excess nitrogen flows from livestock farming systems, that is, the animal concentration. Taxes on animal products have the same limitations as those on inputs, except that products are less well correlated with emissions (Kampas and White, 2002). Nitrogen excretion by animals is not a linear function of production levels, and that there are substantial variations owing to animal density. At the least, it is necessary to distinguish between industrial and small-scale production. (Pan and Hodge, 1994; Hopkins *et al.*, 1996; Lansink and Peerlings, 1997; Berntsen *et al.*, 2003; Bel *et al.*, 2004; Christensen and Hansen, 2005; Verchère, 2010).

Eco-conditionality of CAP subsidies

Eco-conditionality is another means of applying the principle of responsibility by reducing subsidies in case of non-compliance. Implemented in 2003, it was used as an argument for abandoning taxation of nitrogen fertilisers that had been considered in 2006 at the time of the new French water law. The report of the Interministerial Task Force on green tides in Brittany proposed implementing a sanction proportional to the overshoot of the organic nitrogen ceiling that could reach 20% of CAP subsidies, whereas the current system has a flat fee sanction. Not declaring nitrogen flows would also be sanctioned. The principal problem posed by eco-conditionality is that farmers who create environment damage are not necessarily those receiving CAP subsidies. This is especially the case for industrial livestock farming systems that make a predominant contribution to nitrogen excesses but receive few CAP subsidies.

Subsidies

Environment economists are generally against the use of subsidies as an instrument to control agricultural pollutions, except for the special case of system transition assistance or the emergence of groundbreaking strategies. In addition, European Union rural development regulations explicitly state that only practices going beyond requirements of the code of good agricultural practices are eligible for subsidies. This is the case for agro-environmental measures but not for pollution abatement subsidies. The literature also points out that these subsidies can have perverse effects. They encourage products with 'a high pollution content' since the subsidy encourages the expansion of products related to pollutions. In addition, they provide artificial profit to farms with a high nitrogen excess. These subsidies are currently associated with particular technologies, giving them an artificial advantage in comparison to other practices that are perhaps just as effective. In France, subsidising the treatment of liquid manure has led to the generalisation of this practice, even in livestock farming systems where it is not necessarily profitable. Farmers are not incentivised to use the most suitable and least costly methods to reduce surpluses (recycling manure and less use of industrial fertilisers). Thus, French subsidies for the treatment of liquid manure are not an incentive to use less nitrogen. (Mahé and Ortalo-Magné, 2001; Mahé and Le Goffe, 2002).

Combining a quota and financial penalty for surpluses

In the case of nitrogen pollution from livestock farming systems, the economic literature shows that instruments that combine a quota with penalties on surpluses to be the most effective (cap and pay) (Horan and Shortle, 2001). These instruments ensure compliance with the principle of responsibility or 'polluter-payer' and implementation costs are moderate. The most relevant economic indicators in the case of nitrogen emissions in fact are very similar to those of agronomists (see Bockstaller *et al.*, 2014, in this issue): estimated leakages and agricultural practices. Nitrogen balances or indicators obtained from direct measurement (e.g. residual nitrogen in the soil) also have the advantage of being tools that can be used by the farmer to minimise costs by innovating in the context of his farming conditions in order to reduce losses. Seen from an economic angle, an approach to 'nitrogen leakages' is the overshoot of the regulatory standard, which for the Nitrates Directive is a quota or ceiling for the nitrogen supply per hectare. Granting a quota is a 'cost-free' measure and a financial penalty results only when a set limit is exceeded, this measure is thus less penalising than a tax on inputs involving all producers. On the other hand, it presupposes a sufficient body of individual data to establish a nitrogen balance for the farm (purchases and practices) and creates transaction costs and administrative recourse to ensure that each farmer does not pollute beyond his quota.

The creation of quotas leads to a 'market of rights' linked to the reference unit, the land in this case. They are thus not 'rights to produce' but 'rights of manuring'. Economists consider that this market is attractive by offering flexible management of organic waste without the needs for public authorities to organise these exchanges (lower cost) (Le Goffe and Vermersch 2004). Livestock farmers with an interest for treating or exporting their waste could theoretically liberate land, whereas those for whom treatment is costly try to rent land for manuring or reduce herd size. Producers are thus differentiated on the basis of manuring and treatment (Rainelli and Vermersch 2000).

One of the results of implementing 'rights of manuring' is the price increase of farmland since the quantity of available cannot increase to any significant extent. In Brittany between 1994 and 2000, the cost of land increased with pig density with a difference of €2500/ha between 'swine-free' municipalities and those with higher pig densities, and a maximal annual leasing cost for the right of manuring of €100/ha in dense municipalities (capital difference multiplied by a 4% (annual revision rate). The cost of land peaked during this

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period in SEZs, however, probably a partial reflection of the limitations of environmental regulations and perhaps also the existence of treatment subsidies (Le Goffe and Salanie, 2005; Djaout *et al.*, 2009).

The counterpoint to economic arguments is that local populations and environmental associations often oppose the development of manuring markets because this implies the entry of manure in their region. An archetypical case is the land–water GIE (Ille-and-Vilaine Department in Brittany), designed to export excess animal manure from the Vitré region to peri-urban municipalities of Rennes. Opponents argued in terms of nuisances from odours and transport, even increased water pollution in catchment areas receiving waste (even though there was compliance with standards). This example shows that even if the manuring market can reduce nitrogen pollution of water at a lower cost (also true for phosphorus and heavy metals), it does not address the issue of other polluting factors such as ammonia. These disadvantages can be attenuated by suitable zoning, even by specific agricultural practices in some cases.

Finally, from a conceptual point of view, some authors have compared the 'right of manuring' to a 'right to pollute' that is socially discredited (Baron *et al.*, 2001; Lessirard and Quevremont, 2008).

Elements of comparison with Northern European countries

Several types of rights markets concerning agricultural nitrogen have been analysed in the literature and are becoming more common in Northern Europe. Denmark was the pioneer in this field. Its system contains three principal provisions (Kronvang *et al.*, 2008):

1. nitrogen accounting to calculate a nitrogen quota per farm and whose implementation is based on the principle of responsibility;
2. the rules of harmony that link non-industrial productions by imposing organic nitrogen fertilising ceilings that are more severe than those of the Nitrates Directive for large scale swine and poultry farms (140 kg/ha) and finally;
3. zoning the region that defines sensitive areas for nitrate, ammonia and odours, where restrictions are the most stringent.

Danish pig production has been considerably reorganised over the past several years (in The Netherlands as well). The size of livestock farming systems increased substantially and an increasing proportion of livestock farmers has specialised in production of piglets, 30% of which are exported to Germany. This change that probably resulted from the use of comparative advantages, had led to an increased added value of the sector at the same time as complying with the strictest environmental restrictions in Europe and avoiding substantial investments in liquid manure treatment technologies. More recently, The Netherlands have gone in the same direction with the existence of animal quotas per farm since 1986, expressed as phosphate. In 1994, these animal quotas were broken down into land-related quotas, set at 125 kg phosphate/ha, and quotas not related to the land that can be exchanged between farms. This system was probably behind French regulations on the reorganisation of livestock farming systems into SEZs. By authorising the grouping of livestock farms of different species on the same site (internal reorganisation) or different farms on the same site (external reorganisation) on the basis of nitrogen rejections of animals, this regulation implicitly created animal quotas that could be exchanged between farms, this time expressed as nitrogen (Dillon, 2009).

Regime of responsibility or polluter-payer principle

Laws governing responsibility related to environmental issues are a means of applying the polluter-payer principle by courts. The goal of the law is to motivate farmers to develop clean practices to minimise risks of environmental damage by making them financially responsible for the pollution they cause. The European Directive on environmental responsibility (Directive 2004/35/EC) thus sets down a common framework of responsibility in order to prevent and repair damage to animals, plants, natural habitats and water resources, as well as damage to soil. Although environmental damage to water is effectively considered by this Directive, its application remains limited because of the difficulty in proving a cause and effect link between practices and impacts. This is because of the diffuse nature of nitrogen pollution and the complexity of transfer phenomena, leading to substantial variability in response times of aquifers to nitrogen inputs. These scientific considerations compromise the relevance of economic and legal tools. Responsibility of the farmer is thus reserved for only spot pollution and not diffuse pollutions when the fault can be clearly identified, for example, draining a liquid manure pit that overflowed after excessive rainfall, that was also the case for WWTPs.

The concept of responsibility also plays a role in prevention via the obligation to comply with various policing measures required to prevent this pollution. In this perspective, the lack of policing powers of the government has been reproved, as shown by judgments on the eutrophication of certain Brittany coastlines or its condemnation in 2001 to pay compensation to Suez-Lyonnaise des Eaux Company that had previously been found guilty of distributing water unfit for human consumption.

In the case of spot pollution, French law does not yet contain an insurance system covering environmental risks and insolvency of polluting farmers. If this system (facultative but encouraged by the Directive) becomes obligatory its value would be to internalise environmental risks. Insurance intended to identify and reduce risks by suitable incentives (exclusion, audits, deductibles, differential premiums, etc.) would motivate farmers to reduce environmental risks or else pay high-risk insurance premiums. The insurance market in fact internalises risks by applying the principle of responsibility to actuarially expected damage (Doussan, 2005)

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