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## Economic perspectives for the Nitrate policy in Brittany (France)

D. Vermersch, N. Raould

**"THE NITRATE DIRECTIVE AND THE AGRICULTURAL SECTOR IN THE EUROPEAN UNION" workshop 20-22 june 1996 Den Haag**

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### ABSTRACT

This paper presents an overview of the problem implications and policy solutions available for management of nitrogen pollution in the special case of the Brittany region. Firstly, the general situation in respect with water contamination is considered. Then, within the legal context, general and specific regulations are assessed. Then we deal with the agricultural pollution control programme and its implementation in Brittany ; the global cost of the programme is estimated between 12 and 16 billion Francs for the whole France. For Brittany only, this cost is bounded between 2.2 and 2.7 billion Francs. In the final section of the paper, new perspectives of the policy are reviewed.

keywords : Brittany, non polluter-non pays principle, intensive livestock rearing.

### 1. INTRODUCTION

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Considering the fact that supply facilities frequently exceed the norms, about 3% of the French population is served by a water having more than 50 mg of nitrates per liter. Considering water quality, half of the 200 main French lakes (artificial and natural) are suffering of eutrophication. About 80% of the reservoirs used for public water supplies also have an excess of nutrient salts. Eutrophication is also observed in coastal waters. Lakes and reservoirs are affected by phosphorus mainly originating from municipal sources, as well as from agriculture. Problems in marine waters are primarily attributed to nitrate from agriculture. For example in the Bay of Brest, it is estimated that 80% of the influx of nutrient salts originate from agriculture. At the national level the contribution of agriculture to nitrogen pollution is about two-thirds (Etat de L'environnement, 1993).

Even if mineral emissions from agriculture also concern phosphorous and heavy metals, nitrate concentration in groundwater and surface water have received more attention in France. This emphasis is mainly due to the EC Directive relating to the quality of water for human consumption (the Drinking Water Directive). It is today widely agreed that the principal cause of nitrate increase is the change in farming methods. Increased use of chemical nitrogen fertilizer related to a greater intensity of crop yield per hectare was an important factor. Nitrate contamination of groundwaters did not take place overnight but over the last four decades as intensive agriculture began to take-off.

The objective of this paper is to present an overview of the problem implications and policy solutions available for management of nitrogen pollution in the special case of the Brittany region. The paper proceeds with five sections. In the next section the general situation in respect with water contamination is considered . Then, within the legal context general and specific regulations are assessed. The fourth section deals with the agricultural pollution control programme and its implementation in Brittany. In the final section of the paper, new perspectives of the policy are reviewed.

## **2. THE NITRATE CONTAMINATION ISSUE**

This section highlights the relationship between nitrate contamination and the modern development of agriculture. Empirical evidence is first discussed at the French national level. In a second point, the problems arising from intensive livestock are considered through the case of Brittany.

## 2.1. The general problem

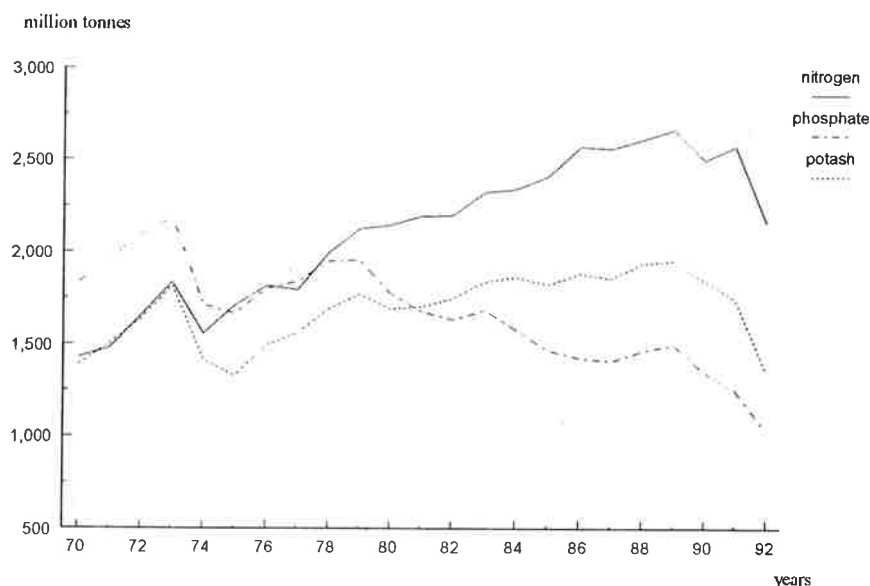
The French agriculture has developed dramatically since the 1950s. At the end of the Second World War there was a social determination to be self-sufficient, since the difficulties in feeding the population were in everybody's mind. Consequently, price support and structure measures encouraging farm amalgamation, modernization, irrigation, mechanization and consumption of commercial fertilizers were adopted. There was also much social expenditure providing the farming sector with retirement premiums to modernize the agricultural sector. In 1994, about only 5% of the French population work in agriculture, whilst this population reached 29% in 1949. Structural changes concerning land use occurred during this period with the transformation of permanent grassland in arable land (Table 1).

Table 1. Evolution of arable land and permanent grassland (1,000 ha).

|             | 1960   | 1965   | 1970   | 1975   | 1980   | 1990   | 1994   |
|-------------|--------|--------|--------|--------|--------|--------|--------|
| arable land | 19 007 | 18 267 | 17 047 | 17 012 | 17 221 | 17 969 | 18 316 |
| grassland   | 13 062 | 13 459 | 13 934 | 13 403 | 12 884 | 11 406 | 10 361 |

Because arable land refers to land under temporary crops, temporary meadows for mowing or pasture and land temporarily laid fallow or idle, the impact of CAP reform is not clear. There were about 17 million hectares during the 1970s and the 1980s. There are now over 18 million. The high cereal price support had led to plough up pastures since the seventies. Between 1970 and 1990 total permanent grassland decreased by 2.5 million. This decrease was greater between 1990 and 1994 (more than 1 million). The transformation of meadows and pastures used permanently in arable land, and the intensification induced by high prices, led to a steady increase of the use of nitrogen, phosphates and potash (Figure 1). This period is also characterised by the large-scale use of pesticides. In France, total pesticide use increased from 25,000 to 1 million tonnes in the 1971-1981 period.

Figure 1. Consumption of commercial fertilizers (Nitrogen, Phosphate, Potash) 1970-1992



Such intensification had consequences on aquifers and surface waters. The Ministry of Health decided in 1981 to establish the extent of nitrate pollution. An assessment was made for each "département" with samples taken at public supply boreholes and rivers and reservoirs. This assessment was mainly based on 1980 data but it also includes available data for 1979 and 1981. The same inventory was carried out in 1988 and 1993. In Table 2 the situation in 1980 is compared to the situation in 1988 and 1993. The distribution of inhabitants according to the quality of drinking water supplied (mean annual nitrate concentration) is also given. The number of persons exposed to high nitrate concentrations has decreased. The supplies where nitrate concentration exceeded 50 mg tend to be located in rural areas where intensive agriculture is dominant. This suggests that there has been an improvement in the quality of the water distributed. In fact, this improvement does not correspond to a decrease in nitrate concentration in raw water. It is rather due to the blending of high nitrate supplies with low nitrate sources, the use of water of new aquifers, or the treating of water by chemical or biological way to remove nitrates. It is clearly demonstrated by the increase of the number of water supply facilities in which nitrate concentration exceeds 50 mg/l once a year.

Table 2. Water Supply Facilities (WSF) and population served with a nitrate concentration over 50 mg/l

|                                    | 1981  |            | 1988  |            | 1993  |            |
|------------------------------------|-------|------------|-------|------------|-------|------------|
|                                    | WSF   | population | WSF   | population | WSF   | population |
| average concentration over 50 mg/l | 584   | 1 160 000  | 707   | 860 000    | 689   | 720 000    |
| exceeding 50 mg/l once a year      | 1 010 | 2 180 000  | 1 074 | 1 700 000  | 1 308 | 5 100 000  |

## ***2.2. Intensive livestock rearing and water contamination***

The development of intensive livestock rearing and its concentration in particular regions has created another important source of nitrogen pollution : that from animal waste. The main part of organic nitrogen is deposited directly on grassland by grazing animals. This poses a lesser problem than high concentrations of organic nitrogen found where there is a high animal density, namely pigs and poultry. In France, Brittany is the region where intensive animal husbandry is the most important. In 1994, pig production in Brittany represented 51.2 % of the French one. This proportion is lower for poultry. Total chickens, turkeys and guinea fowls represented 30.4 % of the French total. For eggs, this proportion is 28.6 %. The total agricultural output for Brittany represents 12 % of the French total, although the agricultural area accounts for only 5 % of the corresponding French total. The comparison between these two figures (12 % of the output and 5 % of the area) gives an indication of environmental problems in Brittany.

Due to its geological features, Brittany has few aquifers, tertiary basins being the only exception. Underground water represents some 20 percent of the total available drinking water (164,000 m<sup>3</sup> per day from 450 boreholes). The 668,000 m<sup>3</sup> of surface water per day from 108 draw-off points, are drawn directly from water courses or from larger or smaller reservoirs. In rural areas underground water accounts for a higher proportion. The quality of these water catchments is very poor, especially in areas where intensive animal rearing is combined with market gardening. For example, in the Finistère (which is one of the four "Départements" of Brittany) 20 % of water catchments are over 100 mg/l of nitrates.

Because of the importance of surface water providing drinkable water and of the intensification of agriculture, Brittany has one of the worst situation in France. A third of water supply facilities occasionally exceed 50 mg/l of nitrates. If physical constraints concerning the volume of water needed for fishes and qualitative constraints concerning the evolution of the nitrate concentration are taken into account there will be a shortage in 2005 ; this will reach 22%.

### **3. THE FRENCH LEGAL CONTEXT**

The legal background of pollution associated with agriculture contains both general regulations and more specific ones.

#### ***3.1. Water protection***

Among the general ones, the Water Act of December the 16th of 1964 relates to the management and distribution of water and to the control of water pollution. This act created the qualitative and quantitative management system for the six major French hydrographic networks through advisory basin committees and executive basin agencies (The "Agences Financieres de Bassin", i.e. Water Authorities). Under that act, these agencies determine and define quality targets for watercourses. Quality and flow problems are viewed economically through a system of charges. Pollution discharges are also subject to strict standards.

A key feature of the Water Act of 1964 was the establishment of a system of charges on water pollutants. This new direction in water policy was in line with the polluter-pays principle but it was restricted to point pollution sources. Charges cover a wide variety of pollutants. They are set through a complex procedure in each Water Authority. Water Authorities also collect the payment of charges whose revenues are then redistributed to the dischargers through the use of grants, soft loans and rewards for abating pollution. Where controlling and monitoring are feasible at low costs, charges are based on individual performance. The Water Act of January the 3rd of 1992 is a more comprehensive act which proposes a balanced management of total water resources. The aim is the protection of the aquatic ecosystems and wetlands, the protection of the quality of surface waters and groundwaters, and a better use of water from an economic point of view. To achieve this balanced management new watershed management schemes were set up.

#### ***3.2. Specific regulations***

Here we examine specific regulations concerning classified installations and the implementation of the EC Nitrate Directive.

##### ***a) Classified installations and intensive rearing***

The Act of July the 19th of 1976 on classified installations for environmental protection, and its implementation orders supercedes the 1917 Act on hazardous establishments which did not cover intensive rearing activities. An

activity coming under this act has to be classified, i.e. listed within a given nomenclature. This applies to livestock rearing installations of a certain size. According to size there is a reporting regime, i.e. "déclaration" or a permission regime, i.e. "autorisation" (Table 3). The permission regime is more exigent, since the applicant has to provide an impact assessment giving details of the source, nature and magnitude of any disamenities liable to result from the installation concerned. Disamenities include noise, use and discharge of water, the protection of underground waters, and waste disposal.

Table 3. Legal regime for classified livestock rearing installations according to species and size

|                            | Reporting regime | Permission regime |
|----------------------------|------------------|-------------------|
| Pigs over 30 kg            | 50 - 450         | over 450          |
| Poultry                    | 5 000 - 20 000   | over 20 000       |
| Rabbits over 30 days       | 2 000 - 6 000    | over 6 000        |
| Veals or fattening bovines | 50 - 200         | over 200          |
| Milk cows                  | 40 - 80          | over 80           |
| Nursing cows               | over 40          |                   |

*b) The EC Nitrate Directive and its implementation*

Three administrative circulars were elaborated by the French authorities, in March 1992, June 1992 and November 1992 to implement the Nitrate Directive in France. The latter explains how to define the vulnerable areas at the regional level. A task force was set up in each "département" to improve coordination and information. The zoning is based on the average level of nitrate concentration during the past years. Waters for which the level of NO<sub>3</sub> is over 50 mg per litre are automatically considered as polluted waters. Consequently the area is classified as "vulnerable". Waters under 25 mg are supposed safe. Special attention is paid to intermediate levels of nitrate concentrations. Time-series are set up in order to define any possible trend in an attempt to foresee any possible problem areas. If the trend indicates a level of NO<sub>3</sub> over 50 mg in 2005, the aquifer or the river is classified as polluted. In the waters where nitrate concentration reaches 40 mg per litre and where time-series data do not exist, the pollution is considered as apt to occur in the very near future.



#### **4. THE AGRICULTURAL POLLUTION CONTROL PROGRAMME**

Since 1975 there has been a clear legal basis to levy charges on non-point sources. In 1982 the water authorities proposed a system of charges per pig according to the number of places available and slurry spreading quality. However this system never entered into application because farmers' unions were against it.

In June 1991, the French government decided to combat against water pollution caused by nitrates from agricultural sources and to introduce a levy on nitric nitrogen. The aim was a progressive introduction of the polluter-pays principle into agriculture as was already the case for other activities. To achieve this purpose, a special agreement was concluded between the Ministry of Environment and the Ministry of Agriculture on March the 11th of 1992. This agreement includes the various European Directives related to water quality and that concerning the protection of waters against pollution caused by nitrates from agricultural sources.

Even if priority is given to preventive means, especially advice to farmers (more efficient application of fertilizers by more accurate timing or rates of application and a better use of animal waste), the place of economic incentives is important. Subsidies are provided to encourage farmers to reduce their pollution by using methods more compatible with the environment, by preventing water pollution by run-off and the leaching of liquids containing livestock manure and effluents from silage, and by processing manure. We will first review research and extension programmes and we will then consider the charge system and the compliance scheme.

##### **4.1. Research and extension**

Since 1984 the French Government has set out the Standing Committee for the Study of Nitrate Pollution (Comité d'Orientation pour la Réduction de la Pollution des Eaux par les Nitrates et les phosphates provenant des activités agricoles i.e. CORPEN).

The CORPEN has been made responsible for preparing programmes to improve certain agricultural operations in order to reduce the nitrate leaching and nitrate run-off. It promotes research projects on technical issues and provides advice to farmers. This committee has also elaborated codes of good agricultural practice adapted to local conditions.

## **4.2. Water effluent charges**

The extension of the charge system achieves a process originated in the late sixties. The basic principle to determine the amount of the charge remains the same. At the moment, these charges cover four substances, for livestock farming : suspended solids, oxidisable matters, reduced nitrogen, phosphates. In the future, other substances e.g. heavy metals and some organic toxins would be taken into account. There are three steps in calculating the levy.

(i) Emission in physical units are calculated for each pollutant and each category of livestock (dairy cows, pigs, poultry ...). This is based on industry average since technical coefficients are used to transform number of animals into quantity of polluting substances. Then monetary coefficients are used to obtain a gross charge per farm. These coefficients are pollutant specific and do not vary according to the various industries.

(ii) Farms are classified according to a number of parameters including manure storage facility capacity, siting of the buildings, run-off from buildings, manure spreading scheme and livestock density. This process leads to 9 environmental classes which are based on individual performances. The abatement of polluting emissions is then estimated for each farm. This outcome is converted into monetary terms in order to obtain a premium per farm.

(iii) Net charge is then obtained, that is to say the difference between gross charge and premium. The charge system and specially the technical coefficients result from negotiations between parties and therefore bear the characteristics of a compromise. It must be underlined that net charges don't include either suspended solids or phosphates because a 100 percent abatement is assumed for these two substances. Farmers will finally have to pay net charge if it is lower than 6458 FF (in 1996), which corresponds to 200 population equivalent. This is the monetary equivalent of farmers' rights on the environment.

The charge system was planned to be gradually enforced, with the following calendar :

- for those rearing installations classified before January the 1st of 1991 charges will be paid from January the 1st of 1993.

- for those rearing installations classified during 1992 charges will be paid from January the 1st of 1994.

- for the whole animal husbandry and crops the charges will be paid from January the 1st of 1995.

For each category subsidies will be given during the year before the levies are charged to help the farmers to meet the standards required. This system was criticised from a theoretical point of view because the regulatory mechanisms to control non point source pollutants are more intricate to implement than those concerning point source pollutants. There are different cost structures for the acquisition of information and informational asymmetries between polluters and regulators can be found. From a political point of view, French farmers protest against the proposed calendar and also against the principle of taxation itself. The farmers' unions argue that agriculture is a special case because of the particular circumstances of the farming economy, of agricultural pollution and agricultural policy. Concerning the levies on intensive animal rearing, pig producers argue that the tax is unfair because mineral fertilizers are not taxed. From an economic point of view the large increase in European pig production has caused prices of pork to fall sharply from around 150 ECU/100 kg in the summer of 1992 to 125 ECU by mid-October before sinking to around 100 ECU in April 1993. Given the continuing increase in pig production foreseen in the EC, there seems to be little prospect of prices increasing over the coming months. So their financial position has deteriorated and they refuse to accept any extra cost.

All these elements led the former government to delay the application of the taxation system. Finally, the biggest farms entered the scheme in 1995. The process is expected to be achieved within a five-year period. Moreover in order to reduce the effect of the charge system on farm income, there is a transitory period during which eligible farmers will only support a fraction of the total amount. For example, in 1995 eligible farmers will have to pay 40 percent of the total, in 2000, 76 percent. This process is expected to be achieved in 2003 when farmers will pay the total amount of the charge.

#### **4.3 Compliance scheme**

All the required information in calculating charges are provided by an environmental audit. This is a compulsory assessment of the farm in terms of its environmental impact. The statement is named DEXEL (diagnostic environnement de l'exploitation d'élevage i.e. environmental audit of the livestock farm). This statement includes two main sections :

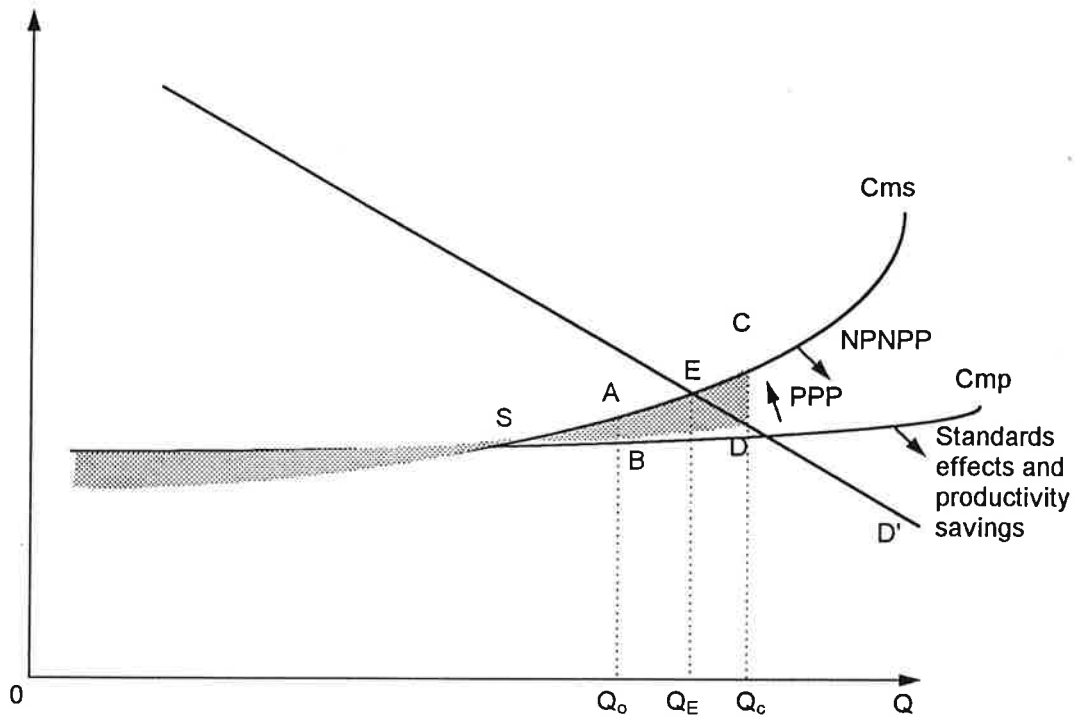
(i) a detailed description of polluting emission flows with emphasis on building siting, storage facilities for manure, run-off, leaching and infiltration.

(ii) an assessment of agricultural practices whose main outcome is a nitrogen balance both on the plot and the farm level. This focuses on the sources of nitrogen surplus.

This statement is used to start a negotiation between each eligible farmer and the basin agency. The objective is to achieve individual agreements whose prescriptions deal with the improvement of farm buildings and the promotion of better farming practices. When investments are agreed on, they are subsidized by the state, by regional and departmental authorities (30% of the amount) and by the basin agency (also 30% of the amount). It must be emphasized that, in addition to the section on building improvements, any contract includes precise prescriptions on farming practices. There are financial and technical commitments involving a classification of the farm in a better environmental class leading to a reduction in the charge amount. Thus before contracting with the agency, every eligible farmer has to trade-off between the extracosts of compliance and the benefits in terms of charge payment.

In return for the conformity of buildings, until 1998, the State and Waters Agencies pay the fee the farmers should pay for pollution.

Figure 2. Perception threshold, taxation and standards effects



From an environmental point of view, the attribution of a perception threshold can be analysed as a property right of the nature for breeders. At the production level  $Q_o$ , it corresponds to an alteration of nature equivalent to area [SAB] on Figure 2. In fact, the social marginal cost  $C_{ms}$  is equal to the sum of the private marginal cost  $C_{mp}$  with the monetary evaluation of the social damage (positively counted) and amenities (negatively counted). Thus, the attribution of a perception threshold can be justified as a remuneration of eventual positive externalities coming from certain regions or production systems (area at left of S).

In fact, the calculated fee underestimates the social damage valorisation. If there was no perception threshold, the amount to pay would be equal to [SCD] at the level of competitive supply  $Q_c$ . Let us suppose now that the social damage valorisation is approximated by the social cost of the agricultural pollution control programme, which is higher than the perception threshold. This valorisation implies a decreasing of the damage and the two curves  $C_{ms}$  and  $C_{mp}$  come closer. If the polluter-pays principle (PPP) is strictly applied, the  $C_{mp}$  curve comes closer the  $C_{ms}$  one and the supply level is  $Q_e$  lower than  $Q_c$ . On the contrary, the public aid associated to the non polluter-non pays principle (NPNPP) gives a supply level between  $Q_e$  and  $Q_c$ . The equilibrium level will be all the closer to  $Q_c$  as the agricultural pollution control programme can induce productivity savings making  $C_{mp}$  fall.

Figure 1 shows a continuity of situations, but in reality there are very different technologies. In practice, the two curves  $C_{mp}$  and  $C_{ms}$  don't always become equal because the agricultural pollution control programme doesn't resolve all the environmental problems. That's why certain breeders will have to pay the fee, for example because of wrong spreading practices. Otherwise, if the state arbitration takes care of the appropriateness between the damage and its internalisation cost, the private arbitration is made between the farmers' financial participation for the agricultural pollution control programme and the fee reduction or productivity savings induced.

From a sample of 500 farms in the "Great West" of France (most of them are integrable in 1994 or 1995), the economy department of INRA-Rennes studied the cost of the environmental programme. The agricultural pollution control programme cost divided by the number of UGB (that is to say 73 kg of nitrogen produced by year) varies with the technical orientation of the farm. Table 4 below indicates this unitary cost calculated with the available data for 1994 and 1995.

Table 4- Cost of the agricultural pollution control programme in 1994-95 for each farm technical orientation

|                    | pigs | milk cows | nursing cows | poultry | pigs-poultry | cows-poultry |
|--------------------|------|-----------|--------------|---------|--------------|--------------|
| number of cases    | 212  | 69        | 77           | 22      | 81           | 33           |
| cost/UGB in francs | 770  | 2540      | 2130         | 630     | 1550         | 1380         |

This table points out differences between costs varying from 1 to 3. They can be explained by the act on classified installations : the application was stricter for soilless breedings, especially for storage capacities. Thus, bovine breeders still have works to make.

Table 5- Effect of a 5% increase of the animal production level on the cost of the agricultural pollution control programme

|  |                    |
|--|--------------------|
|  | Soilless breedings |
|--|--------------------|

|   | Bovine breedings | in a structural excess area | out of a structural excess area |
|---|------------------|-----------------------------|---------------------------------|
| initial class of animal waste salvage 3     | +2%              | +2.9%                       | +2%                             |
| other initial class of animal waste salvage | +0.9%            | +2%                         | -0.3%                           |

The first econometric estimations allow us to see the effect of a 5% increase of the animal production level (bovine or soiless) on the cost of the agriculture pollution control programme (Table 5). The negative sign for the soiless breedings with a bad initial environmental situation is the effect of the act on classified installations : the cost for the agriculture pollution control programme only is in reality a supplementary cost, decreasing with the breeding size. So, concerning the renovation works which are to be made, soiless breedings out of a structural excess area are favoured. Requirements in relation with nuisance emission are stricter in areas where spreading possibilities are insufficient. However, in each case, an increase of the production level enjoy economies of scale for renovation work cost. Whatever the production, the marginal production increase will be cheaper (in term of renovation work cost) for breedings having a quite good initial environmental situation.

The study of factors explaining the unitary cost of the programme allows us to calculate a global cost of the agricultural pollution control programme. Thus, we statistically have three types of effects :

- a size one because of economies of scale, in particular for storage buildings. For the next years, the unitary cost should increase : with a base 100 in 1994-95, we should obtain 138 in 1996, 140 in 1997 and 150 in 1998.
- an initial environmental situation one. The cost is all the more important as the initial situation is bad. To calculate the cost in the next years, we have to make hypotheses about the number of farms with a bad initial class of animal waste salvage (17.5% for soiless breedings and 45% for the other ones - estimated from the actual sample)

- a spreading surface one : the smaller it is, the higher the cost. To extrapolate the results, we suppose that the next integrable breedings have a spreading surface proportionally equal to that of currently integrable farms.

Knowing the number of integrable farms for each year of the programme, and the number of UGB it represents, we can calculate the global cost of the programme corrected by the effects announced above. Making some hypotheses, the global cost of the programme is estimated between 12 and 16 billion Francs for the whole France. For the only Brittany, this cost is bounded between 2.2 and 2.7 billion Francs. The cost for Brittany represents around 18% of the total amount for the national programme. In fact, this rate is higher in the first years of the programme because of the regional cattle population : it's estimated around 40% for 1994 and 1995. We must finally notice uncertainties about the number of integrable farms and the quantity of pollution they represent, which must be underestimated. That's why we can suppose the real cost is in the upper part of margins. The estimation is so doubled in comparison with the 7 billion Francs estimated at the beginning of the programme.

## **5. CONCLUSION**

The new policy implemented in the livestock sector relies on the same basic principles which have steered water policy for three decades. Enforcing charges on polluting emissions from livestock farms is a straightforward application of the polluter-pays principle. This could give farmers a good incentive to reduce emissions. But in contrast with other industries there is a huge number of farmers thus establishing environmental audits and agreeing on individual contracts. It is potentially very costly for the public budget. Transaction and administrative costs could represent a significant proportion of total expenditures. Moreover control and monetary issues received little attention. Future development of the policy will depend on future compromises between public authorities and farmer representatives. The present balance between farmers and public interest benefits farmers. But things could change in response to different political and environmental pressures. The crucial issue will be the benefits (market and non-market) of this programme for society. Great attention will be devoted to the evolution of freshwater nitrate content and of coastal waters eutrophication. These are the key parameters for the general public.



The agricultural pollution control programme stake is very important if we consider the degradation of water quality in some regions or its cost. The first interrogation is about the efficiency of the programme. In structural excess areas, where spreading surfaces are insufficient, the successful outcome of the programme depends on animal waste treatment installations with an acceptable cost. But, for now, those installations aren't absolutely technically efficient and their cost is high. Moreover, it can induce a concentration of farms because of economies of scale in individual or collective treatment installations. This risk is all the more important as those processes allow a decrease of the necessary spreading surface.

Finally, for breeders who do not comply with the classified installation regime, because of an overproduction of more than the 25% of the strength of herd authorised, the renovation works financing agreement allows a regularization of their situation. Thus, the community confirms illegal practices of such farmers. There is here an equity problem if we think of the farmers who had made renovation works before and without any aid.

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