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Evaluation of the environmental impact of the CAP (Common Agricultural Policy) measures related to the pig, poultry and eggs sectors

Executive summary

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1 PREAMBLE

The CMOs studied

Since the end of the 1960's, the pig and poultry sectors (meat and eggs) have been governed by agricultural policies under the EU framework. These policies are part of the general framework of the Common Agricultural Policy (CAP) as defined by the Treaty of Rome and more specifically in the pigmeat, poultrymeat and eggs Common Market Organisations (CMO), drawn up in 1975. As opposed to some other sectors of the CAP, these sectors have received relatively limited Community support. The principal instruments are:

- those of the import regime: import duties and export refunds,
- aid for private storage limited to pig carcasses, being applicable when the "cycle" associated with this production is at its highest, and prices fall,
- exceptional market support measures taken when these sectors face major public health crises.

Objective of the evaluation

The objective of this study was to evaluate the effects of the application of these instruments on the environment, given that many other factors also have an influence on the evolution of these sectors and on their environmental effects. These factors include among others: the continuing improvement of the sector's performance, the changes in society's expectations concerning the quality of the products and animal welfare, the changes in production costs, competition between production zones and products, the changes in the structure of exchanges, and the integration of environmental concerns into agricultural policies. Farmers have adjusted their production choices, geographical location and methods of production under the influence of these factors. These adjustments may also have had effects on the environment.

In addition, the successive reforms of the CAP in 1992, 1999 and more recently in 2003, have gradually shifted the instruments, from strong price support towards decoupled direct payments[1], thereby reducing the environmental effects of CAP implementation. These reforms have also reflected an increase in environmental awareness within EU policies, especially with reorientation of the supports from the first pillar to the second, as set out by the Cardiff process, which aims at better integrating environmental concerns into sectoral policies. A series of environmental and animal welfare measures have thus gradually appeared, such as agri-environment measures and cross-compliance, as well as horizontal environmental policies (nitrates, IPPC, and NEC directives, etc.) at Community and national levels.

The objective of this evaluation was to highlight the causal relation between the factors outlined above, including the CMOs, and the environmental effect of the sectors. The study covered the period from 1993 to 2009. It focused on the EU-15, but preliminary indications on the environmental effect of the CAP measures in the three sectors for the 12 member States (MS) having joined the EU after 2004 are also provided.

2 TOOLS AND METHODS USED AND LIMITS OF THE EVALUATION

In addition to the tools commonly used for structuring methodology (i.e., preliminary description of the sectors and CMOs, thus ensuring building of a logical framework model for intervention and leading to comprehension of the questions, evaluation criteria and indicators), we have also used the following methods:

- selection of the relevant data from the Farm Structure Survey (FSS) and the Farm Accountancy Data Network (FADN) databases to determine the main structural changes over the period and the changes in profitability of the units,
- identification, classification and exploitation of the scientific and technical literature on the subject, as well as evaluation reports on the main environmental directives: nitrates, IPPC; NEC, etc. in the MS studied and at the EU level,
- design and implementation of 19 national studies and 10 regional case studies[2], in the sectors concerned. In each one of these studies, representatives of authorities (agriculture, environment, etc), operators (producers, co-operatives and traders, the downstream sector, chambers of agriculture, etc) and other key persons (research centres, environmental NGOs, etc) were met, and semi-structured interviews were carried out following a common method. In each case study, around 20 producers of each sector under review were interviewed face to face.

[1] The 3 studied sectors do not benefit however from these direct payments.

[2] All these studies were carried out starting from a common model produced by the central team.

Table 1 : List of Member States indicated in the ToRs for a detailed study by sector.

	DK	FR	GER	HU	IT	NL	PL	SP	SWE	UK
Pigs	**CS**	**CS**	**CS**				**CS**	**CS**		
Poultry				**CS**	**CS**					**CS**
Eggs						**CS**			**CS**	
Key	MS with national study by sector					MS with regional case study by sector				**CS**

All of the data gathered was analysed and checked by the central team, who used them as a basis for formulating the judgments of this report.

Besides this collection and data analysis, the intervention logic used to answer the evaluation questions was always based on the following sequence:

- **studied factors** (CMO, other policies, and other non-political factors) **having (or not) effects on farmer behaviour** (e.g. intensification, concentration and specialisation of the farms, etc.) and on the evolution of the sectors (e.g. a regional concentration of farms, improvement in performances, etc.),
- **these possible changes having (or not) an impact on animal welfare and the environment** (e.g. effluent production, gas emissions, etc) that affect (or not) environmental aspects such as water, soils, air, biodiversity and landscape.

The principal limits of this report are:

- that the field studies were carried out only in the main producing MS and not in all the MS,
- the fact that the FSS, import, export and implementation data were not complete or were difficult to interpret (e.g. change of FSS method for one year),
- the technical and scientific literature and the data on the environmental effects of the three sectors, although numerous, do not provide a complete answer to the precise question at the EU level. The results are often presented for a particular issue and/or one Member State only; the produced data are often for agriculture and/or breeding as a whole, and not for the sectors studied; the methodologies employed by the various authors often differ largely on the same subject, etc.,

3 EFFECT OF THE CMOS AND OTHER FACTORS ON PRICES AND PRODUCTION

Market-oriented CMOs

As mentioned earlier, the CMOs relating to pigs and poultry are considered as relatively light and market-oriented in nature, when compared with other sectors of the CAP. The three types of instruments – import regime, aid for private storage (pigs only) and exceptional market support measures in the event of an animal disease crisis – act jointly to stabilise the market. This results in facilitated export and/or storage in the event of overproduction, the limitation of imports and fewer problems in the event of a public health crisis. We did not, therefore, single out these instruments in our analysis.

We did, however, take into account the evolution of the contents of the CMOs, distinguishing three sub-periods:

- 1988 - 1994 corresponds to the period before the Marrakech agreements and thus to when the import regime was at its strongest. However, our evaluation covers only one year of this period.
- 1995 - 2001 is the period following the Marrakech agreements. Border protection and export refunds persist, but were gradually reduced.
- 2002 - 2009 is the period during which, while waiting for the negotiations of Doha Round, the quotas subsidised through export refunds remained fixed by the agreements of the URAA[3], but were not transferable from one year to the next. In practice, the export refunds were almost never implemented. Moreover, the social concerns of public health, animal welfare and environmental protection came more and more to the forefront during this period.

Moderate effects on prices and on production

The CAPSIM model[4] results and the accompanying theoretical analysis show that measures at the borders – export refunds and tariff barriers – would have had an effect (compared to the counterfactual situation without any instruments) on the price rises in the three sectors under review: 2.6% and 2.3% for pigs respectively in 1990-92 and 2000-02[5], 11.6% and 10.4% for poultry and 17.2% and 5.9% for eggs, during these same periods.

[3] URAA: the Uruguay Round Agreement on Agriculture

[4] CAPSIM is a partial equilibrium model focused on agriculture. It enables a simulation of the effects of public policies on the sectors and exchanges between the EU and the rest of the world. It was adopted in this study because it had already been used in an evaluation on the effects of the CMOs of the 3 sectors in 2005 (Agraceas 2005)

[5] Unfortunately, the modelling work stopped in 2000-2002. However, we have carried out additional theoretical analysis based on the level of use of border instruments, which continued to decline, thereby confirming this steadily decreasing effect of the CMO on prices and production over the period.

Outside of these periods, the absence of models led us to conduct supplementary analysis, based on the use of the instruments, which shows that the effects of the CMOs have probably decreased further. This effect was particularly significant for poultry (meat and egg laying), but far less so for pigs. It clearly decreased over the period, in particular after the implementation of the Marrakech agreements in 1994.

This increase and stabilisation in price also resulted in an increase in production, but to a lesser extent. Thus, for the 3 sectors, these increases estimated by the CAPSIM model and its accompanying theoretical analysis – compared to a counterfactual situation without these instruments – would have been 2.6% and 1.4% for pigs in 1990-92 and 2000-02 respectively, 11.8% and 6.6% for poultry and 14.6% and 4.3% for eggs, during the same periods. Thus, as in the case of prices, this effect was especially significant for poultry, but much less so for the pig and egg sectors, and it clearly decreased over the period.

At the same time, over the period 1993-2008, the production of poultry meat increased by 28%, pigmeat by 26%, and the production of eggs was stable. These increases are significantly higher than those estimated for the instruments of the CMO by the model[6]. They show that on the one hand the sectors developed well beyond the effects of the CMO (except in the case of eggs) and on the other that the increase in production continued, even though the effects of the CMO strongly declined over the same period. Therefore, other factors can also explain this rise in production, such as:

- the profitability of the breeding units, which is considered as good over the period (although customarily cyclic), especially for the large units, and which shows an improving trend[7],
- significant progress in terms of techniques and genetics, which have led to improvements from between 5 to 15% of the feed conversion ratio[8] in all the sectors. In the porcine sector, the fertility of sows improved by about 4 to 5 piglets/sow/year over the period. The production of laying hens also improved, with an increase in the number of laid eggs/hen/year, of between 17 and 35, depending on the MS,
- increase in demand. Consumption in the meat poultry sector increased by 23% for the 10 largest consumer MS in the EU-15, as did exports, which showed a rise of 62% from 1993 to 2007 for the EU-15. Similarly, for pigs, consumption increased +10% for the 9 largest consumer MS of the EU-15 and was largely supplemented by a rise of 112% in exports for the EU-15. Only the egg sector was stable in comparison, from the beginning to the end of the period, in spite of some fluctuations in between.

Thus, even if the CMOs contributed to an increase in production, the main drivers of this growth were, in our opinion, the sectors' improvement in performance, coupled with an increased demand. This is confirmed by our investigations carried out with the producers in the case studies, who for the most part put these improvements down to technical progress and the drive for profitability. The environmental obligations were also mentioned by a little more than half of interviewees, whereas the CMO measures are mentioned only by less than 1/5 of them.

Development of alternative farming directly related to consumer expectations

Alternative farming (organic farming and types of farming according to other specifications often related to the environment and animal welfare) developed over the period. It was especially the egg sector that – in practically in all the EU countries – developed a significant alternative sector (market share of 8% of total EU-15 production in 1996, as opposed to 32% in 2008), even dominating the market in some cases (e.g. **Sweden** and the **United Kingdom**). Alternative farming also developed for poultry, but only in certain MS (e.g. **Italy** and **France**) and for pigs, on a more exceptional basis (e.g. **France**, **Spain** and, for organic production, **Denmark**). Among these types of alternative farming, organic pig and poultry production is very limited (less than 1.5% of the total production in almost all the MS studied), but organic egg production is significant among the MS studied, ranging

[6] The table below shows the increase in production calculated according to the model (vs the counterfactual situation without instruments), compared to the actual increase in production noted in the sectors.

		1990-92	*1995-97*	*2000-02*		*2008*
Pigmeat	Base	15,184	16,277	17,838		19,026
	Without border instruments	14,790	15,976	17,580		Not modelled
	Price evolution due to the CMO (source CAPSIM)	**2.6%**	**1.8%**	**1.4%**		Not modelled
	Actual evolution of the production	**-**	**7,.2%**	**17.47%**		**26%**
Poultrymeat	Base	7,048	8,392	9,234		9014
	Without border instruments	6,217	7,718	8,624		Not modelled
	Price evolution due to the CMO (source CAPSIM)	**11.8%**	**8.0%**	**6.6%**		Not modelled
	Actual evolution of the production	**-**	**5,2%**	**31%**		**28%**
Eggs	Base	5,260	5.240	5.718		5489
	Without border instruments	4,491	4,730	5,475		Not modelled
	Price evolution due to the CMO (source CAPSIM)	**14.6%**	**9.7%**	**4.3%**		Not modelled
	Actual evolution of the production	**-**	**-**	**8.7%**		**4.4%**

Note: The increases in production noted in 2008 are not calculated compared to the 1990-1992 average for the CAPSIM model, but compared to the year under review, which is 2003. This explains the slight discrepancies observed.

[7] Farm Net Value Added / agricultural working unit grew for the 3 sectors over the period.

[8] Ratio of the weight of feed provided to the animal to weight at slaughter

from 1% in **Poland** to 8% in **Sweden**, and it is on the increase everywhere. The CMOs have had, in our opinion, no effect on the development of these types of farming, which are strictly linked to changes in consumer preferences. One of the most conclusive examples is the ban by certain distributers in the **Netherlands**, **Belgium**, **Sweden** and **Germany** of eggs laid from battery hens. These sectors show characteristics of specialisation, concentration and regional concentration often similar to the conventional sectors, but are generally made up of farms smaller in scale and less intensive[9]. We have, however, very little quantitative information on these differences.

We can thus see that a certain number of sectors that take into account environmental and animal welfare standards beyond the legal regulations showed positive development over the period, as they reacted directly to the expectations of a growing number of consumers who are willing to pay a higher price in exchange for quality and/or a more ethical way of producing.

4 EFFECT OF THE CMOS AND OTHER FACTORS ON THE OTHER CHANGES IN THE SECTORS

An extremely high concentration of livestock in big farms over the period, accompanied by continuing specialisation

The expansion of production is obviously linked to a parallel increase in the number of livestock. Thus, over the period in the EU-15, the pig sector increased from 105 million head in 1990 to 121 million in 2007, which represents an increase of 15%. For meat poultry, these levels were 492 million birds vs 621 million, representing a 26% rise. For laying hens, the figures remained more stable, with 380 million in 1990 and 374 million in 2007, with a peak in 2000 at 401 million birds.

At the same time, farms became very concentrated in the three sectors and in almost all of the EU-15 MS. Thus, the size of the breeding units progressed over the period very significantly, by 164% for pigs[10], by 177% for meat poultry[11] and by 153% for laying hens[12]. The number of animals in large units has therefore increased. Hence, meat poultry farms of more than 50,000 chickens account for 89% of chickens in the **United Kingdom** and 78% **in Hungary**, and pig units with more than 5,000 pigs account for 35% of farms in Denmark. However, it must be noted that there are big differences between MS. At the same time, the number of livestock in small units regressed.

Specialisation[13] also continued, but to a lesser extent. Thus, the share of production coming from specialised farms increased about 10 to 20% for both pigs and poultry, depending on the MS. In the already very specialised egg sector, this specialisation continued to grow in almost all the MS and reached very high levels, such as 92% in **Spain** or 81% in the **Netherlands**. Hence, in the three sectors the majority of the production comes from farms focused on these sectors.

The increase in these two phenomena of concentration and specialisation are directly related to the economies of scale that large farms can take advantage of, unlike small ones, and which enable them to continue in business. The analyses carried out on the FADN clearly show this difference in profitability between the large and small structures (Farm Net Value Added / work unit is multiplied by 2 to 4 depending on the sectors and the categories). Moreover, the enforcement of environmental standards could have been another driver of these changes, as it put the most efficient farms (the bigger ones according to our FADN analyses) in a better position to adapt to the new rules, which often entails heavy investments and increased administrative costs.

Regional concentration economically coherent but problematic from an environmental point of view

In the three sectors, the farms are often very concentrated in specific regions. We can even see all three sectors come together in specific regions (e.g. Brittany, Cataluña, etc), as is the case with other intensive sectors such as dairy breeding. These rearing-house units are in fact often developed in regions unfavourable to field crops, with poor soils and/or farms of a small size. Farmers in these regions have sought to increase their income by using intensive breeding units and so use animal manure to fertilize their soil. The opportunities offered by port infrastructures that make it possible to import at competitive prices have also played a role.

According to our analyses, the drivers of this trend in regional concentration are, above all, economic factors and in particular the pursuit of economies of scale and of conglomeration, which reduce transport costs, especially for the purchase of feed and of young animals, and for better diffusion of knowledge, etc.

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[9] In the study "Carbon footprint of conventional and organic pork" in the 4 MS studied (GER, DK, NL and the U.K.), the average sizes of the studied organic herds are about a quarter to a half of those of the conventional ones. The biggest difference is in Germany (47 sows vs 170 = 28%) and the smallest is in the **Netherlands** (143 vs 263 = 54%)

[10] Change in the average unit size in the EU-15 from 90 to 238 pigs

[11] Change in the average unit size in the EU-15 from 486 to 1 347 chickens

[12] Change in the average unit size in the EU-15 from 151 to 383 hens

[13] Measured through the share of production produced by specialised farms

Livestock buildings increase in size but modernise slowly

Over the period, livestock buildings increased in size and were modernized, with more than 80% of units installing incoming air ventilation (but less than 20% with treatment of the air extracted) and automation of feeding systems and of manure evacuation, etc.

The interviews carried out during the field studies indicated that environmental regulations are the main drivers of these changes, as well as the rules concerning hygiene and animal welfare (e.g. meeting the standards of hen cages, enlarging pig stalls, etc.). In addition, it seems that the rural development programmes may have been used for financing building improvements (beyond baseline regulatory requirements), as were some national programmes.

Parallel to the effect of the regulations, economic factors have also tended to push the producers to increase the size of their units, in order to make economies of scale and thus increase their herds. The need to reduce production costs has also encouraged them to reduce their energy use, whether it be lighting, ventilation or the drying of droppings in the egg sector, or water consumption. This pursuit of lower production costs came up very clearly in the interviews with the producers.

5 PRESSURES ON THE ENVIRONMENT DUE TO CHANGES IN THE SECTOR

As pigs and poultry are generally kept indoors, any environmental pressures are primarily related to the production and management of effluents. These pressures can be on soils and water through effluent spreading, but also through the gas emissions originating from the animals and effluents.

Significant (but not unique) quantities of effluents from the three sectors

Based on provided data and estimates, we were able to determine that, in the MS studied, the annual effluent production was about 190 million t/year for pigs and approximately 28 million t/year for poultry (meat and laying). These effluents would represent approximately 920,000 t of nitrogen, 435,000 t of phosphorus and 575,000 t of potash for pigs and 530,000 t of nitrogen, 290,000 t of phosphorus and 440,000 t of potash [14] for poultry.

In the MS and sectors under review, the average approximate share of these elements, in the total application of fertilizers on the cultivated lands, would correspond to approximately:

- 9% of the organic nitrogen (effluent) as well as mineral (fertilizers) applications,
- 25% of the phosphorus, and 28% of the potash mineral applications (data on the organic applications are not available for these two elements).

These national average values can of course hide much higher values in areas with high levels of livestock concentration.

We do not have information on the evolution of these quantities, but, in spite of improvement in the consumption rate over the period, it is probable that the quantity of manure evolved almost proportionally to the animal population, which increased by 15% for pigs and 26% for meat poultry (laying hens having remained stable). On the other hand, their composition greatly changed due to significant improvements in feeding and genetics, as mentioned above.

In terms of the share of total manure from livestock breeding in the MS under review, the three sectors represent from 11%[14] of this manure in **France** to 54%[15] in **Denmark** (including 49% for the porcine sector). Except in **Denmark**, bovine manure constitute the majority of manure production.

Very limited CMO effect on this manure production

Considering that the results of the CAPSIM model used to calculate the effects of the CMO on production are reliable, and assuming that the increase in production was reflected proportionally in the production of manure, the additional level of effluents due to the existence of the CMO instruments would, depending on the periods, be from approximately 3 to 1% for pigs, 12 to 7% for poultry and from 15 to 4% for eggs. Overall, this confirms the limited and decreasing influence of the CMO on the environmental pressures of the sectors (with the most pronounced production effect on poultry production).

Storage capacity for effluents increasing, but still room for improvement

According to a CEMAGREF study, a vast majority of the MS under review increased their effluent storage capacities, which now reach over 6 months' capacity in many MS. As storage capacities have to be calculated for the periods during which spreading is prohibited/inappropriate, they thus vary depending on the MS and their climatic conditions. Hence, it is noted that these capacities are significantly higher in **Denmark** and a little less so in the **Netherlands** due to the climatic conditions in the north of Europe, but also because of more constraining environmental regulations. Concerning the equipment, the majority of the MS have a very high proportion of

[14] 33 million t/298 million t

[15] We do not have information about absolute value, but only in % terms

uncovered field storage; exceptions are the **Netherlands** and **Sweden**. Even if checking for leaks is compulsory in all the MS, this only seems to be under control in certain MS. Our analyses show that the development of building equipment for the collection and storage of manure was especially influenced by environmental regulations. By and large over the period, a reduction in the negative environmental impact (on soils, water and air) of the practice of collecting and storing effluents is observed, thanks to the increase in storage capacities and the checking of leaks. However, this varies greatly among the MS: the MS with the most constraining environmental regulations have the best results over these parameters.

Spreading of liquid manure generally carried out in the most harmful manner

Apart from **Poland**, where manure production is very developed, buildings for pigs in the other MS are equipped mainly for slurry production. In the case of laying hens in cages, it is more common to produce droppings rather than liquid manure. For meat poultry we do not have detailed information.

In general, for pig production the level of slurry has tended to increase compared to manure, when the method of breeding on straw or sawdust litter allows a reduction in the quantity of nitrogen for spreading much greater than the reduction in liquid manure. On the other hand, this is counterbalanced by greater gas emissions. For laying hens, due to the development of free range breeding instead of cage breeding there has been a move towards manure production instead of droppings. Environmentally this is rather neutral.

The spreading of pig slurry and poultry droppings is carried out in a similar manner in the MS under review (60 to 80% by liquid spreaders for pigs and by solid spreaders for poultry), except for the injection of pig slurry into the soil, which is carried out in more than 80% of cases in **Denmark** and the **Netherlands,** where it is compulsory. Thus the slurry is generally (except for the MS quoted above), spread in the most harmful way for the environment (e.g. maximum emission of ammonia and odours). Poultry effluent poses less of a problem, because it can be exported out of the areas of high concentration thanks to its low density and its very good agronomic value.

There are nevertheless still too many farmers who do not know the composition of their farm effluents, and many of them acknowledged in our investigations that progress concerning spreading can still be made.

High concentration of livestock in the regions can be problematic

We did not find any publications that compare the management of the environment between small and large farms. While the risk of lacking available land increases along with the size of the units (even if this is not proven by our studies based on FADN), what comes out from our discussions with authorities and operators in the field studies is that the large farms that exceed IPPC (Integrated Pollution Prevention and Control) declaration and authorisation thresholds are subject to many more procedures and controls during their creation and operation than the smaller ones. This is likewise the case for those subject to cross-compliance. They are accordingly usually forced to comply more thoroughly with animal welfare and environmental measures than those that are checked less frequently. In addition, these same farms often have easier access to advice and can make investments in these fields more easily than smaller ones, thanks to their superior profitability as shown by our FADN data analyses (the variation of profitability per working unit ranges from 1 to 4, depending on the size of the holdings). Therefore, though we are not certain on this point, we cannot say that increase in the size of the units has a negative effect on the environment.

The crucial point concerning these concentrations is whether or not there is a lack of available land to spread the effluents on. Therefore, it is the regional concentration of the farms which appears to us to be the greatest issue in the development of this farming. Hence, comparing the maps of regional concentration of livestock for the three sectors with those regions with a nitrogen surplus clearly shows that it is in fact the areas with high concentrations of livestock that have the highest surpluses of nitrogen, even if this appears relatively obvious. We can thus clearly see that, in the areas where the number of animals is too high, the farms are not able to find satisfactory solutions to manage their effluents and that this results in strong pressures on the area, in particular through a surplus of nitrogen and phosphorus.

The particular case of alternative breeding

The zootechnical performances of the alternative productions are lower than those of conventional breeding in all the sectors, even if they did improve over the period. Thus, many publications note that the environmental pressures of alternative farming are stronger than those of the conventional ones. However, in these studies the organic sectors do not systematically, for all the parameters, come second: for the production of food and for transport, they are better ranked than conventional farming in terms of carbon footprint. In addition, these alternative breeding methods have positive environmental effects in terms of a greater diversity of breeds and, for organic breeding, the organic production of cattle feed.

However, other authors, by taking other impact assessment methods, come to opposite conclusions. Therefore, it seems that work remains to be done in this field to reach undeniable conclusions, taking into account all the factors influencing the evaluation results. For example, it does not appear obvious to us that the approach per kilo of product, used in many of these studies, is sufficiently exhaustive. In particular, the level of consumer consumption of these various products could be taken into account, in order to have a full analysis. Consequently, we cannot make a conclusion on this subject.

Reduction in the polluting effects of effluents over the period

The studies carried out over the period concerning animal feedstuffs show that the concentration of N, P and K in pig effluent decreased very significantly over the period thanks to advances such as multiphase feeding[16], which decreases the nitrogen content of the effluents by around 5 to 7% compared to a single-phase feeding for pigs, and from 15 to 35% for poultry. The use of phytases[17] has also been very widespread, and this also makes it possible to reduce phosphorus rejections by around 25 to 30%. This is taken into account by producers and their feed suppliers in order to improve, above all, their economic performances. But by reducing the nutrient content of the effluents, their economic interests in fact also generate environmental benefits. In addition, these improvements also contribute to reducing the animal and effluents gas emissions.

With regard to effluent treatment, many techniques exist, but on the whole these treatments are not so frequently used and concern only a minority of effluents. Among the interesting examples of treatment, one can note in **Germany** and in the **Netherlands** significant programmes of biogas production from pig slurry. However, these projects are being developed only in the framework of programmes concerning renewable energies and thanks to a good repurchase price of electricity making these operations profitable. These programmes are not, properly speaking, a complete treatment of slurries, as the nitrogen is not treated by this fermentation. It does, however, make it easier to transport compared to slurry, as nitrogen is concentrated in the digestate. In **Spain** 14% of the farms treat their effluents. In **France**, 10% of pig effluents in Brittany are treated in manure stations. As in the case of meat poultry, the treatment of droppings has increased (9% of the holdings in 2004 compared to 4% in 1994) but remains very marginal. Lastly, in the **United Kingdom**, 17% of poultry effluents are incinerated and 40% are used to produce energy (biogas).

Nevertheless, effluents are still problematic

In conclusion, from these data we can notice that the effluents arising from the three types of breeding represent very high sources of nutrients that can be used to fertilize the soil. However, in the zones where there are surpluses, these effluents can create serious pressures on the environment, especially in areas where the livestock is very concentrated or where there is combination with other sectors.

In spite of a rise in the numbers of pigs and meat poultry during this period, a certain number of genetic and technical advances concerning feedstuffs have led to a significant decrease in the polluting effect of the effluents.

On the other hand, at the farm level, we see that, of changes directly related to environmental performances, the only spontaneous changes are those that are directly profitable for the farmers (ex: reduction in feed conversion indices). For the other changes that have led to better effluent management and less pollution, the analyses clearly show that it is in the MS where environmental regulations are stricter than elsewhere that there was very significant progress.

Lastly, it should be highlighted that the sectors under review are not the only ones to pressure the environment. Other livestock farming, fertilizers on crops, and urban and industrial gas emissions also contribute to these pressures.

6 EFFECTS OF PRESSURES ARISING FROM THE THREE SECTORS ON THE STATE OF THE ENVIRONMENT

Effects on the environment difficult to establish

The main pressure on the environment by the sectors under review is through the manure production and management, as the animals are generally kept inside. These pressures are mainly due to the spreading on the soil and the release into the air of potentially pollutant. The main elements which can cause problems are:

- for soil and water: nitrates and phosphates resulting from the spreading of effluents, as well as the ammonia emissions resulting from the effluents (at the farm as well as during spreading),
- for the air and climate change: greenhouse gas effects (CH_4 and N_2O), which mainly result from effluents. Odours and dust can also constitute local pollution.

These emissions from the three sectors under review must be considered in the wider context of many other agricultural sources (e.g. effluents and emissions from other types of livestock breeding, mineral fertilization of crops, etc), and non-agricultural pressures (e.g. urban and industrial pollution) that contribute simultaneously to these pressures. The effects of these pressures on the same areas are thus generally impossible to attribute to one specific source. However, we have tried to measure the relative weight of the sectors under review, in comparison to the other sources.

Undeniable effects on water at the local level, although decreasing on average

[16] The composition of feedstuffs is adapted to the age and/or the physiological state of the animal (ex. for poultry: starting feed, then growing and finishing, and for pigs: weaning, fattening, etc.).

[17] Phytase is an enzyme which improves the digestibility and the assimilation of total phosphorus of vegetal raw material.

In terms of total fertilizers spread on cultivated lands, in the MS studied the three sectors under review constitute approximately 9% of total nitrogen (organic plus mineral), 25% of total mineral phosphorus and 28% of total mineral potash. This shows that, without underestimating the effects of the sectors under review on aquatic resources, the state of these latter do not depend mainly on the three sectors. In particular, we show that – surprisingly – significant quantities of mineral nitrate fertilizers continue to be spread on cultivated lands in areas with already very high effluent surpluses.

However, excessive spreading of effluents does impact on water quality and does add to the phenomenon of eutrophication of aquatic resources. Thus, many water pollution problems persist in zones with high livestock density. Certain zones or MS clearly appear to have high surpluses of nitrogen (e.g. **Brittany**, the **Netherlands**) and of phosphorus, showing a strong imbalance between animal load and land available for spreading.

In spite of the above-mentioned reduction in pressure per animal, analyses of the trends in water quality in the case-study regions do not show significant changes over the period. Our studies show that the pressures (from the three sectors and others) may not have ceased, but we have seen that pressures from the three sectors are generally diminishing on cultivated lands. However, the process of restoring water quality (including all pollutants) is always slow – even very slow – due to the inertia of the milieu and to the variety of other activities and related pollution in watersheds. Possible improvements will in any event take time to materialise. This is confirmed by extensive literature.

Concerning water resources in quantitative terms, livestock production does require a degree of water consumption, but to a much lesser extent than for crop irrigation. However, this use of water resources may also have affected aquatic ecosystems in the zones where this resource is scarce.

Less critical but still real effects on soil

As in the case of water, the effects of porcine and poultry farms on soil are especially linked to excessive or continuous inputs of fertilizers or toxicants, since the animals are mainly kept inside. These excessive inputs, as well as NH_3 fallout, have led to acidification[18] of soil, which can be detrimental to plant growth or to terrestrial and aquatic ecosystems.

These emissions cause nitrogen to fall on to the soil, which in the areas with very high livestock concentration can reach up to 50 to 60 units of N/ha/year. Elsewhere, recordings of 10 to 20 kg /ha/year are not rare. The share of NH_3 agricultural emissions in the EU-27 attributable to the sectors under review is 16% arising from pigs, 7% from meat poultry and 3% from laying hens. These emissions have in general fallen over the period. Consequently, the pressures of acidification have been lowered, even if progress is still possible. This is shown by the edifying results of the MS that have implemented stricter environmental regulations (**Denmark** and **the Netherlands**). In these countries, the reductions of NH_3 emissions over the period 1990-2007 reached 42% and 46% respectively even in spite of the fact that in **Denmark** the pig population rose by 21%.

The reduction in the total acidifying emissions in the majority of the OECD countries in Western Europe led the European Environmental Agency (EEA) to estimate that more than 90% of the ecosystems in Europe are protected from further soil acidification. The EEA report nevertheless highlights considerable regional variations from the point of view of ecosystem protection.

With regard to the toxic elements in the soil arising from animal breeding, laying-hen droppings spread regularly in the same place can cause zinc and copper pollution. Moreover, we show that these metals are often unnecessarily excessively present in these animals' feedstuffs.

A rather limited effect on greenhouse gas (GHG) and some MS that show the way

With regard to the GHG, the share of agriculture in CH_4 emissions in the EU-15 in 2002 was estimated at 58%, of which 39% was due to enteric fermentations and 19% due to the management of the effluents. The CH_4 of the enteric fermentation of ruminants accounts for between $^2/_3$ and ¾ of agricultural emissions, depending on the MS. The level of these emissions fell in the EU-15 by 8.7% over the period 1990-2002[19]. Data on the share of pig and poultry emissions do not exist, and we have only some examples collected in the literature, which indicate that pig and poultry contribute to 1/5 to 1/10 of CH_4 agricultural emissions. N_2O, which is also a GHG, is estimated to have been responsible for 64.5% of total agricultural emissions in the EU-15 in 2002. However, the main source is the use of mineral nitrate fertilizers, which accounts for 89% of the emissions.

In spite of the considerable methodological limits, this analysis shows that the bovine sector (and in fact all ruminants) have a much greater impact on the climate, because they are responsible for the large majority of emissions and make a greater contribution to global warming. It must be remembered that the entire emissions for the three sectors will still take place at a "global" level, whether the animals are produced in the EU or not. Thus, if effluent is well managed, as is the case of some MS (e.g. **Denmark**, **the Netherlands** and **Sweden**), it seems more judicious to us to proceed in this way and reduce the emissions of the EU farms, rather than to think that producing these animals abroad will somehow cancel out the emissions and solve the problem.

[18] The potential of acidification corresponds to the total measure of the acidifying potential (release of H+ ions) of ammonia and sulfur dioxide (SO_2). It is quantified in terms of equivalent SO_2: 1kg of NH_3 is equivalent to 2.3 kg of SO2.

[19] We do not have more recent data.

With regard to the odours, very little literature exists, so we are not able to make conclusions.

In the buildings themselves, NH_3 can be found in great concentration, and it has been shown that this directly affects the health of both human beings and livestock. However, animal housing has greatly improved over the period, and now 80% of it is equipped with mechanical ventilation of incoming air.

Little documentation on impacts on biodiversity on several levels

In terms of the biodiversity of the species bred, OECD studies and IRENA indicators indicate a seemingly contradictory evolution over the period, with reduction in the number of species used for breeding at the same time there is expansion in the range of main species dedicated for production. However, information for the three sectors under review is rare. In addition, the majority of countries have implemented conservation programs intended to protect and reinforce the populations of threatened breeds.

In terms of natural biodiversity and habitats, the farming methods of the three sectors can have consequences. Indeed, land and aquatic wildlife can suffer from air and water pollution caused by excessive spreading of effluents and the consequent gas emissions. Many scientific publications show that excessive spreading of fertilizer causes the development of neutrophilous species and the loss of biodiversity in the fields concerned. This affects not only the flora and fauna, but also the micro-fauna and flora in the soil. However, the spreading of effluents can also have positive effects on biodiversity and soils, if they are spread correctly and more especially if the soils need organic matter.

Notwithstanding that a number of ecosystems can be affected by pollution resulting from the excessive spreading of porcine and poultry effluents in the EU, the breeding of pigs can also sometimes be associated with the conservation of the diversity of ecosystems. The pasture lands of pigs in the "Dehesas", in **Spain** are home to the black and red Iberian pig (Cerdo Iberico), even if only 40% of the herd is exclusively fed from these lands.

Finally in terms of landscape, very few studies are available on this subject, but incontestably the livestock buildings have impacts which affect agricultural landscapes.

Indirect impacts for feed production

In addition to the potential damage caused by harmful spreading of effluents, one of the major environmental impacts of these three sectors concerns the production of feed (primarily cereals and protein crops). Some of these effects have already been studied in the evaluation of the environmental effects of the CMO of arable lands in the EU. Other effects that take place outside the EU were not studied because they are not included in the Terms of Reference, in spite of the very significant impacts which some of them can have, such as the deforestation of tropical forests in order to cultivate soya.

Progress is made, but there is still much to do

Thus, we can draw the conclusion that pig, poultry and egg productions have an effect on water, soil, air, climate, biodiversity and landscapes that is directly related to the level of production, but the problematic issue lies in the regional concentration of these activities.

The results of our analyses show that the main drivers of changes in the sectors – and thus of those leading to environmental impacts – are above all the market, the technical progress and organisation of the sectors. The CMOs play a rather minor role in these changes. It is always difficult to attribute environmental effects to any particular activity, as many activities occur simultaneously on identical territories. Thus, even in the zones with a high concentration of porcine and poultry breeding, the effects noted in all the environmental domains can only be partially attributed to each source, and our analyses show that the sectors under review are never the only, nor the principal, polluter at the regional level. Nevertheless, significant progress can still be accomplished.

7 COHERENCE OF THE THREE CMOS WITH THE COMPULSORY INTEGRATION OF ENVIRONMENTAL PROTECTION IN THE CAP

Our analysis shows that the CMOs are not completely in coherence with the obligation to integrate environmental protection in the CAP. But in the case of these very "limited" CMOs, without any direct payment to producers, it is difficult to use this channel to implement instruments that could have an environmental effect.

However, although the porcine and poultry farms are not subject to cross-compliance by means of the CMO[20], our national and regional studies have shown that a vast majority of the farms concerned with production in these sectors have been subject to cross-compliance since the 2003 reform because they benefit, for other reasons, from direct payments. Through this channel, cross-compliance applies to almost all farms, including the porcine and poultry units. By this mechanism, we can say that the aids to the sectors are in better coherence with the compulsory integration of environmental protection in the CAP since the 2003 reform.

[20] This is not possible in terms of regulations insofar as cross compliance is a mechanism which is aimed at reducing the direct payments to the producers, in the event of non compliance of certain rules, but in these three CMOs, the producers do not get any direct aid.

However, other environmental policies (e.g. nitrates directive, IPPC directive, etc) have significantly compensated this weakness, especially at the beginning of the period when cross-compliance did not exist.

8 EFFECT OF MEASURES FROM OTHER POLICIES[21] ON THE ENVIRONMENTAL PERFORMANCE OF THE THREE SECTORS

The answer to this question was mainly based on an analysis of the bibliographical resources used, opinions of actors collected from national studies and case studies, as well as results stemming from the aforementioned questions

Extra environmental costs

The three sectors under review must face extra costs[22] due to environmental requirements. In Europe these represent an estimated 1% to 2% of production costs for the porcine sector and 8% for poultry (meat and eggs). For the later (meat and eggs), this would explain a cost difference ranging from 20 to 25% between the European countries and third-country poultry producers[23].

The positive effect of these costs is that they encouraged innovations for obtaining productivity gains. These regulations are sometimes regarded as the "value added" difference for European farming.

Variable limitations on production levels due to regulations, depending on the sectors

Except in certain cases (e.g. in the Vulnerable Zones in **France**), the overall tendency has been the limitation of production levels due to the influence of environmental regulations.

. For the porcine sector, the limitation of herd numbers and production was observed to some extent. The regulations do not seem to have prevented a rather moderate level of increase in production, even if we can consider that, without the limitations, this increase would certainly have been even higher.

. With regard to the meat poultry sector, in the majority of countries the policies seem to have had only a slight impact on the level of production. However, the future implementation of European regulations (e.g. animal welfare directive in **Spain**, IPPC directive in the **United Kingdom**), has given rise to some fears among the actors that there will be a negative effect on production levels in the coming years.

. It is undoubtedly for the laying-hens sector that the regulation standards (in particular concerning animal welfare) and the increase in production costs have had the greatest influence on the production ceiling. Although we cannot measure its importance precisely, we can consider that, since 2003, these measures have contributed to the limitation of egg production observed in the EU.

Regulations which have influenced improvement in the sectors' technical performance and contributed to limiting increase in productivity

Scientific literature as much as studies carried out in the producer countries indicate that the environmental regulations have very directly influenced the tendency towards improving technical performances and breeding practices in the three sectors under review.

According to the persons interviewed, the regulations under review – in particular the Nitrate directive (through reduction in inputs per area unit, management plans for slurry and manure, etc.) and the Animal Welfare directive (on limitations of livestock density) contributed to limiting increase in productivity of the three sectors:

. For the porcine sector, by slowing down intensification, these regulations led to the current state of stagnation in the number of head/UAA ratio.

. For the poultry sector (both meat and laying), the tendency was often towards "extensification" as a way of complying with the new constraints on density. Thus, here as well, the regulations seem to have very clearly influenced the significant reduction in the intensification of these farms.

Regulation having a dual opposite effect, encouraging concentration (a need to reach a critical size) and, at the same time, its limitation (through thresholds and ceilings)

In general, it is noted that the regulations contributed in limiting the concentration of porcine production to some extent and in concentrating that of laying and meat poultry.

But the influences are actually more complicated; in the three sectors we in fact note that the regulations on the concentration phenomena work in two opposite directions and to differing degrees depending on the countries:

- on the one hand, the cost of the legal requirements seems to encourage concentration of production, by pushing the small producers to give up their production and the producers with larger farm holdings to expand

[21] Mainly Nitrates directive, IPPC and NEC directives, cross-compliance of the direct supports, RDR schemes, etc.

[22] These necessary "overcosts" guarantee environmental protection and correspond to an "internalisation of the environmental externalities", i.e. to an integration of the cost of environmental protection and of measures relating to animal welfare in the production costs.

[23] The rest of the difference being due to other factors, such as labour costs, feed stuff prices, size of the farms, etc.

(e.g. porcine exploitations in **Germany** and **Poland** or egg production in **Spain**, the **Netherlands**, the **United Kingdom** and **Poland**)[24]

- on the other hand, the thresholds, ceilings and other constraints of the various regulations (such as the rules concerning spreading), contribute to limiting to a certain extent the concentration of production, in particular locally for the vulnerable zones of the Nitrates directive, (e.g. porcine farms in **France**, **Denmark** and **the Netherlands** or meat poultry production in the **United Kingdom** and in **France**).

A regulation that furthers specialisation of farm holdings in the pig sector but not in the poultry sector

In addition to market influences, we noted rather clearly that the external political factors (with the need for high investments, the spreading surface, etc) encouraged the specialisation process in the various countries under review for the pig sector and, depending on the countries, towards particular specialisations (e.g. weaning in **Denmark** and the **Netherlands**.).
On the other hand, except for **Spain**, the regulations under review seem not to have had any significant effect on the specialisation phenomena in the meat and laying poultry sector.

Varied effects on the changes concerning regional distribution

It appears that even if the national regulations implementing the EU directives (in **Spain**) or national regulations (in the **Netherlands**) sometimes clearly contribute to limiting the regional grouping of farming, this situation sometimes remains unchanged because the economic advantages they provide are greater than the regulation constraints (**Germany**). In certain cases, the regulations, such as they are implemented in the MS, have even been able to lead to a certain degree of regional concentration (e.g. in **France** with (i) the establishment of a compulsory effluent treatment threshold in the structural surpluses areas, which encourages the setting up of porcine farms in Brittany, as their investment capacity is higher than those of other sectors and (ii) their grouping together in order to pool their means, in particular for the treatment of effluents). Finally, in certain countries, it is considered that these political factors are not, or not at least to any great extent, influential on regional concentration (e.g. **Hungary**, **Italy**, **Poland** or the **United Kingdom**).

The animal-welfare regulation as an incentive for developing alternative production in the laying hen sector (only)

The environmental regulation seems to not have had a significant effect on the development of alternative farming for the pig sectors (presented as a positive step, but non decisive, in **Germany**, **Poland** and in the **Netherlands**) and of the meat poultries sector.

On the other hand, the regulation – in particular relating to animal welfare – has clearly contributed to the development of alternative farming in the egg sector, in several countries.

An essential driver for the improvement of the infrastructures

Whatever the sector, and even if it is noted that there are some variations between MS, environmental and animal-welfare policy factors (Community and/or national regulations and aid) have been the main drivers of improvement in infrastructures.

The requirements resulting from the Nitrates directive seem rather to have had an impact on effluent storage and management equipment, whereas the Animal Welfare directive (a matter of concern for the laying hen sector) mainly dealt with animal housing infrastructures. The IPPC directive, whose goal is integrated pollution control, has concerned both of these, especially on farms with large herds. In this way, certain national tools (PMPOA in **France**, or the regulation on manures and fertilization in **Poland**) have encouraged farmers to improve the infrastructures for management and storage of their effluents. Aid (Community, via the Rural Develpment Policy – RDP, or national) has also facilitated compliance with the infrastructure standards (**Poland**, **Hungary**, **France**).

A critical effect on the improvement of effluent management

It appears very clearly that the regulations had a determining effect on the improvement of effluent management. With regard to storage, the significant improvements took place in particular through national transposition of the Nitrates and IPCC directives. The latter appears (for the farms which were subject to it, and therefore those with the highest number of livestock) as being the preferred way of storage facilities monitoring and control and even of effluent management. This is done by attributing licenses to farms and setting up BAT (Best Available Techniques). For many countries, national programmes encouraged the holdings to improve their storage conditions.

Cross-compliance seems, on the one hand, an important tool for applying "pressure" on the producers who benefit from CAP direct payments in terms of effluent management requirements, and on the other as a monitoring tool by and for the farmers.

[24] In some specific cases, the IPPC directive has pushed some producers not to expand the size of their installations, just so to stay below the thresholds, thus avoiding obligations. But this remains marginal in comparison to the general trend.

Under the influence of these regulations, many examples of national or regional measures aiming to improve effluent management were raised in the various MS under review (several national regulations specifying the conditions of treatment, creation of a consortium for the management of agricultural residues in Catalonia - **Spain** -, common installation of treatment stations in Brittany - **France** -, etc.).

Two directives in the forefront: Nitrates and IPPC

During our analysis of the various environmental regulations, the work on the two directives concerning Nitrates and IPPC showed that, while there is still room for progress, these directives represented major advances in limiting environmental pressures emanating from the sectors under review.

The majority of the stakeholders we met within the framework of the study estimate that the external political factors had an important impact on their farming practices and thus on the pressures on the environment. The points which were generally mentioned are:

- The effect of the Nitrates directive, which in particular led to a reduction in the pressures relating to farm animal effluents (by the introduction of the limitation – first to 210 kg[25], then to 170 kg – of organic nitrogen/ha/year from animal manure in the vulnerable areas, and of resting periods during which spreading is prohibited, along with storage of the effluents and the drawing up of management plans for the effluents, etc.), resulting in a clear reduction in the levels of nitrogen loads in many countries.
- The effect of the IPPC directive, along with the implementation of the BAT concerning improvement of the effluents (in quality and quantity) and that of the gas emissions being better managed at the farm level. It is considered as being the preferred method of follow-up and control for the storage installations and effluent management, via the attribution of farming licenses for the farms with the highest number of livestock.

Alongside these two major directives, there was also mention of the beneficial effects brought about by the NEC directive (for NH_3), through the measures accompanying the RDP (Agro-environment measures), through the setting up of the good agricultural practices, through the Animal Welfare directive (which has an effect on the infrastructures of animal housing, in particular in the egg sector), through certain regulations or national measures and through the addition of the cross-compliance (which includes the implementation of the directives).

Slow and for now limited effects on water and soil quality

Even though there is little scientific literature devoted to the study of the effects of the regulations and measures on the environmental impacts of the sectors concerned, a certain number of environmental effects arising from these factors can, nevertheless, be identified.

Various articles and reports presenting the effect of the regulations and support programs directed towards the reduction of water pollution by effluents (in particular the recent EC evaluation of the Nitrates directive), show that in the EU there is no clear evolution concerning the concentration of nitrates (there is as much improvement as there is deterioration).

Given the slowness of migration phenomena, many of the effects of the policies (in particular the Nitrates directive) can be observed only after many years or even decades (for groundwater). It has nevertheless been possible to observe that the combination of measures (Nitrates directive/IPPC) and aid for equipment in the areas most concerned with livestock farms seems to lead to a reduction in the nitrate content in water, even if this concentration still remains too high. But, on the other hand, the situation often deteriorates in the areas not subject to constraining regulations.

For the future, wider application of the Nitrates directive and improvement in monitoring the various pollutions would make it possible to follow these types of pollution better, to better evaluate the effectiveness of the regulation and thus to protect the resources of water and soil better.

Little-known effects on air quality and indirect impacts still to be studied

The information gathered regarding the air issue had more to do with pressures than with impact on air quality.

The positive effects of the various regulations under review (in particular NEC, IPPC, indirect Nitrates directive and certain national regulations) on limiting the environmental pressures have been shown previously. Thus we can logically assume that these factors had a positive effect on air quality, at least in terms of limiting its declining quality, without however being able to specify to what extent.

One of the interesting points highlighted is the fact that the Nitrates directive contributes to limiting a certain number of atmospheric pollutants. As these measures limit and prevent water pollution from nitrates, they also prevent the atmospheric emissions of nitrogen compounds, and this to a significant degree. We can thus consider that improvement in the application of the Nitrates directive (in particular through increasing the surface area of vulnerable areas), would have a dual positive effect: on soil and water quality on the one hand, and also on that of the air, on the other.

[25] Limitations for the use of organic nitrogen coming from manure spreading, according to the Nitrates directive, were initially enforced with a limitation of a maximum of 210 kg/ha/y from 20/12/1998 and then of 170 kg /ha/y from 20/12/2002. Moreover, when creating a new vulnerable area, the limit is 210 kg N/ha/y during the first four years and then 170 kg N/ha/y.

One consideration raised, in particular in connection with repercussions on air quality, is that of the secondary impacts in the domain that can be generated by environmental regulations. We saw, for example within the framework of the analysis, that in some regions the restrictive regulations forced the sectors to make choices about how to deal with eliminating effluents. For several of them, chosen options included incinerating effluents in power stations, or transporting them far from the farm to be spread on other farms and setting up treatment stations. In these cases there could be questions concerning: (i) direct effects on the environment (in particular air emissions), (ii) indirect effects on the environment (such as those concerning transport), (iii) their "profitability" in terms of energy assessment and global ecology.

Very little information on the effects of biodiversity and landscapes

Information available concerning the effect of environmental regulations on biodiversity and landscape is very limited. This is undoubtedly related to the fact that the regulations themselves are not very restrictive regarding these subjects. However, we can mention the existence of directives on habitats (92/43/EEC) and birds (2009/147/EEC, previously 79/402/EEC), whose aims are to maintain and improve biodiversity, but this zoning concerned only approximately 12% of agricultural land in the EU-15 in 2004 (EC report on Rural Development in 2006).

It would undoubtedly be relevant to make sure that there is better coherence between agricultural sector regulations and the European strategic directions concerning the maintenance and the restoration of biodiversity.

9 RECOMMENDATIONS

One of the major conclusions of this report is that these CMOs have had little impact on the phenomena observed over the period of this evaluation. This is not very surprising, since the budgets allocated to these CMOs are limited in comparison to other sectors of the CAP and especially since these CMOs do not provide any direct payments to the producers. Consequently, it is rather difficult to make recommendations that concern the CMOs themselves. At most, an extension of cross-compliance could be suggested, but a very large majority of the farm holdings are already subject to it because they benefit from direct payments. Accordingly, we have oriented the scope of our recommendations towards the implementation of environmental directives within the three sectors under review.

Although the environmental regulations are necessary and have led to a number of improvements, they are not completely sufficient in their current state.

Among the areas of progress identified during this evaluation, several relate to the Nitrates directive and its implementation alongside other regulations (IPPC directive, cross-compliance, and national regulations). Indeed, we have seen how this directive occupies an important place in the "landscape" of environmental regulations and of progress resulting from them. However, it has a certain number of weaknesses, or at least possible room for improvement. The following aspects could, in particular, be examined:

Our interviews indicate that, currently, the "ceiling" for spreading nitrogen as laid down in the Nitrogen directive is often regarded by the farmers as the "right to pollute" up to this limit, rather than as a level never to be reached. Even if progress has already been made, several measures would make it possible to advance even further in the direction of greater pollution control, among which the following can be mentioned:

- **better informing/raising the awareness** of the actors in the sectors (particularly producers) regarding the use of fertilizers in a more moderate way, whether they are organic or mineral, so that they are able to have accurate knowledge of: (i) their effluent production and its composition, (ii) their obligations in terms of storage and treatment, (iii) the various usage and treatment/elimination options and techniques at their disposal, and (iv) crops needs and optimal conditions for spreading manure on the soil;
- encouraging the Member States to set up, as is the case in certain countries, **regulations aiming at limiting the regional concentration of livestock farms**, which causes pollution concentration;
- **supporting the research, development and dissemination** of agricultural technical practices that use less inputs.

Even if the concept of "**balanced nitrogen fertilizations**" in vulnerable areas is well defined in the Nitrates directive, its transposition and practical implementation varies greatly depending on the MS and regions. It would thus be worth clarifying its definition, supported by concrete guidelines, so that the MS have a more consistent approach than today on the matter, in particular in terms of calculating this balance and the means to reach it.

Along the same lines, some MS have also legislated **to establish rules outside vulnerable zones**. We think it's advisable to encourage this process that makes it possible to tackle the problem of nitrate pollution before water quality becomes damaged.

Certain MS have set up **constraining measures on the use of phosphorus** in agriculture, as it is the main element responsible for the eutrophication of rivers. It would be judicial if other MS, at least in the problem areas, followed the same preventive route rather than waiting until the water quality of rivers reaches a level requiring curative measures. This would undoubtedly cause additional difficulties for spreading effluents in those areas which have a surplus, but this would be the price to pay for better river and coastal water quality.

We saw that some unsatisfactory spreading and storage practices persist in many MS. Here again it would be useful if the MS that currently place few constraints on these polluting practices were to look to those MS that have obtained positive results thanks to stricter legislations (e.g. compulsory injection into the soil of slurry, drainage and treatment of effluents resulting from the storages of manure and slurry, etc.), without the need for legislation at the Community level. Examples already exist; this is the case in particular for the **conditions of spreading and storage** in the Netherlands, Denmark or Sweden.

We have seen that certain techniques of effluent management (e.g. incineration) raise questions in terms of a global environmental assessment, but we did not come across any comparative detailed studies on the matter. Carrying out studies/research would make it possible to have a **better understanding of the effects of the various means of treating effluent** (on-site / outside the farm, injection / treatment stations / incineration, etc.) and would be very useful, especially in the context of an exhaustive economic-environmental assessment.

Without envisaging any drastic or quick change of practices towards alternative systems in all farms, and even if the comparative advantages of the various systems still need to be studied further in depth, it would be advisable to continue measures that encourage the **reconversions of farms, for those who wish it, to more extensive production systems (e.g. organic).**

In addition, while these productions have in the past experienced high profitability, international competition is increasingly tough, and farmers have more and more difficulty affording environmental and animal well-being related expenditures. This is at least true for the small-scale farmers. Allowing some **investments in environmental matters** to be financed through the **RDR or national aid** would undoubtedly make it possible to solve two problems at the same time: how to maintain small family-sized farms and how to reduce their harmful effects on the environment.