Assessment on nitrogen flows and livestock farming in France. Main issues and proposed solutions

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1. Background

Livestock consumes large amounts of agricultural products and is a major source of reactive nitrogen. Moreover different economic and societal factors contributed to a concentration of livestock in the West of France, leading to an increased pressure on the environment. The surplus of N causes pollution especcially in the atmosphere, water ressources and coastal ecosystems. France is presently challenged by the European Commission on the implementation of the Nitrates directive.

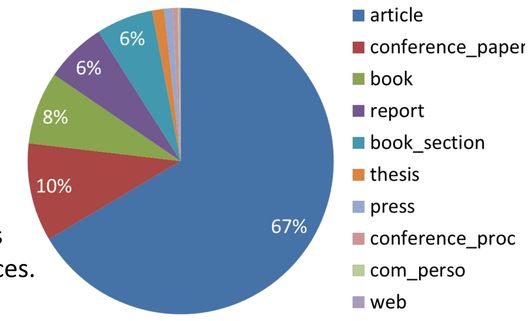
2. Objectives

A collective expert assessment was conducted in 2011. Its objectives were to

- make a synthesis of updated knowledge on N flows in livestock farming activities on different scales, from the animal to the regional scale with a specific focus on the farming system scale. This considered the different forms of nitrogen (nitrate, ammonia, nitrous oxide, others) and the link with impact.
- make a comparison between different livestock systems.
- identify several possible actions in livestock breeding systems, e.g. improved techniques and management, change in the system, territorial and economic incentives.

3. Methods

The expert assessment was based on an analysis of the literature by a panel of 22 scientists from a wide range of disciplines: animal sciences, agronomy, social sciences, biogeochemistry, etc.
1332 references were analyzed from 272 scientific journals; 82% after 1998.
3/4 of the references were on biophysical processes (of which half on N fluxes in livestock farming systems and approx. 20% on indicators), and ¼ in social sciences.



The references were also analyzed according to the journal which they were originating from, the origin of the authors and the main topics of the assessment.

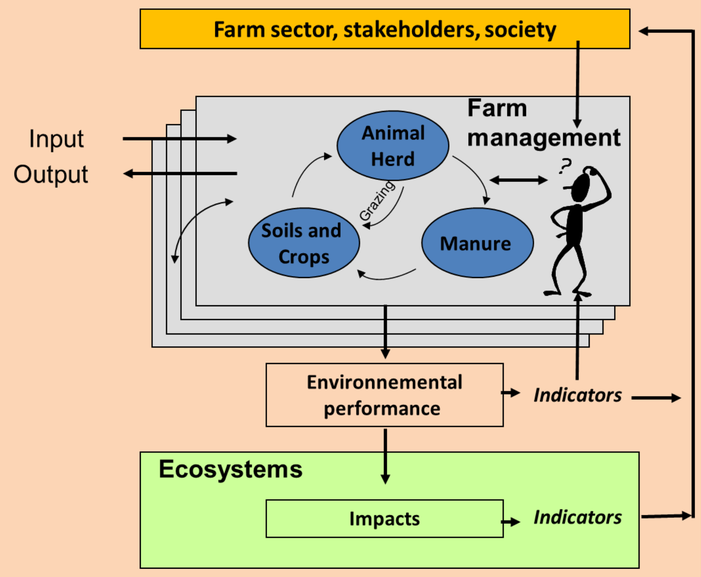
4 Results

This section makes a synthesis of the main findings.

A framework to analyse livestock farming system

Choices in N management are taken by farmers. But they involve:

(i) Herd unit, manure management , soils & growing crops.
(ii) Groups of farms or local organisations where deals may open new opportunity for N flows control.
(iii) Environmental issues linked to farming activity
(iv) Stakeholders with their policies and social debate.



➢ Specialisation and concentration amplify problems.

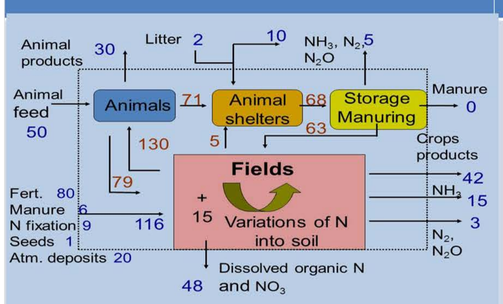
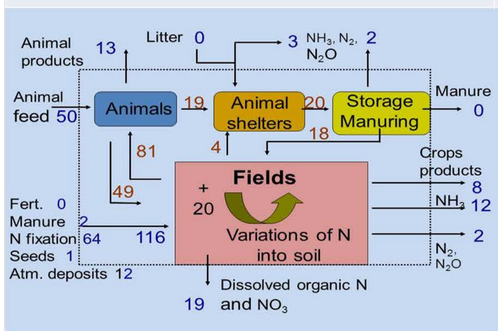
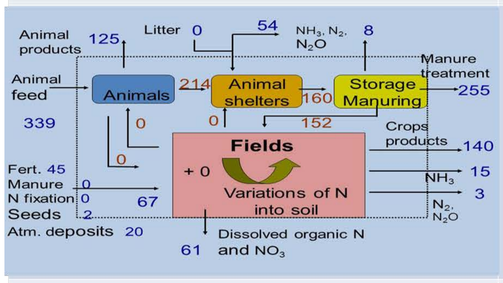
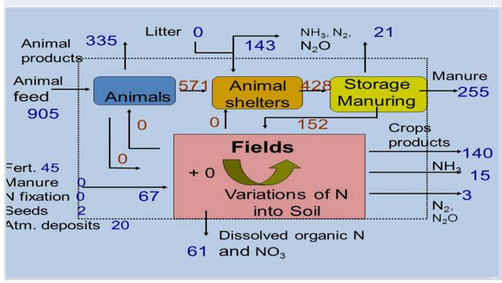
Throughout the 20th century, the agricultural system moved from mixed farming to specialized systems and increased concentration in animal husbandry due to economic rationality and agroindustry pressure. West of France presently concentrates half of hogs and poultry and 20% of cattle on only 6% of farmland. Consequently, livestock farming has no longer sufficient land for providing feed and spreading manure. Scientific literature underlines that this technical and economic logic locks the system into a path dependence because firms and farmers are strictly connected in their activities.

➢ A complicated legal frame did not reach the objectives.

The French nitrogen regulations framework is characterized by a overabundance of plans that make it difficult to find a compromise between agreeing with the European directives, maintaining the production and reaching environmental aims.
The problem of pollutions progressively entered into the public debate. Questions arose on livestock farming practices. These criticisms have also to be considered in terms of the farmers plight to society in general.

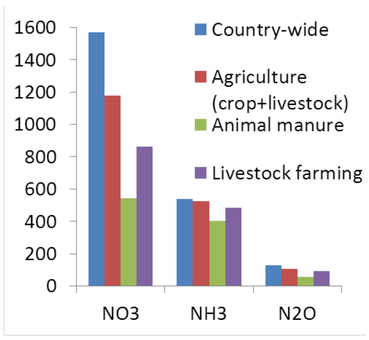
➢ N farm budgets are convenient methods for improving nitrogen management.

The budget has to take into acount all the flows related to the farm in order to screen every source of waste and every way to progress.

Medium Nitrogen Flows	Farm system	Budget kg N / ha	Farm-gate	Soil –system
	**Dairy farm + Crops** 80 ha UAA, 82 LU 25 ha Crops West France	Input	148	238
		Output	72	177
		Balance	76	61
	**Organic Dairy farm + Crops:** 160 ha UAA, 107 LU, 65 ha Crops East France	Input	87	134
		Output	21	93
		balance	46	41
	**Pigs Farm + Crops** 84 ha UAA, 150 Sows, breeding & fattening West of France	Input	386	199
		Output	285	140
		Balance	121	59
	**Pigs Farm + Crops** 84 ha UAA, 400 Sows, Breeding & fattening Manure Treatment (60%) West of France	Input	952	199
		Output	730	140
		Balance	222	59

➢ Livestock farming provides major part of nitrogen flows.

In France for very long, nitrogen issues in livestock farming have only been considered from the point of view of water contamination by nitrate. However, livestock farming has a prominent place in the whole N cycle: it is the main provider of atmospheric ammonia (90%) and N_2O (>70%) and accounts for more than 50% of nitrate.

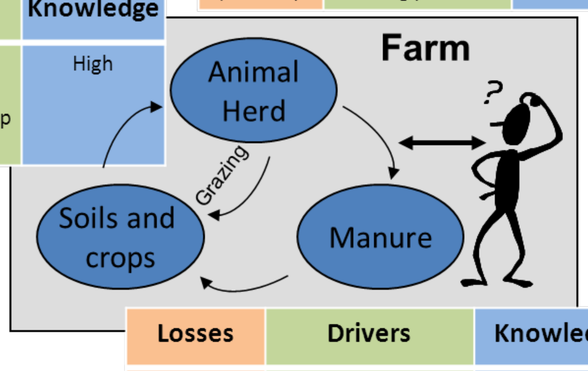


➢ N efficiency is low for one animal but it increases at the farm scale thanks to internal recycling

A minority of N input is exported in products: eggs, milk or meat. Limited progress can still be made with feed recommendations. Margins are higher for farms thanks to internal recycling. The N balance results from complex interactions and thus an improvement at one stage can be cancelled by a bad management at a previous or next stage.
Grazing reduces N emissions because there is no storage and grass absorbs N directlyfrom excreta.
Globally, N efficiency in livestock farming is around 40-50%.
It decreases when N input increases.
Low input and organic farming show the highest N efficiency.

Efficiency	Drivers	Knowledge
Medium *(40%)*	Production intensity Farming system: grassland, legumes, crop rotation	High

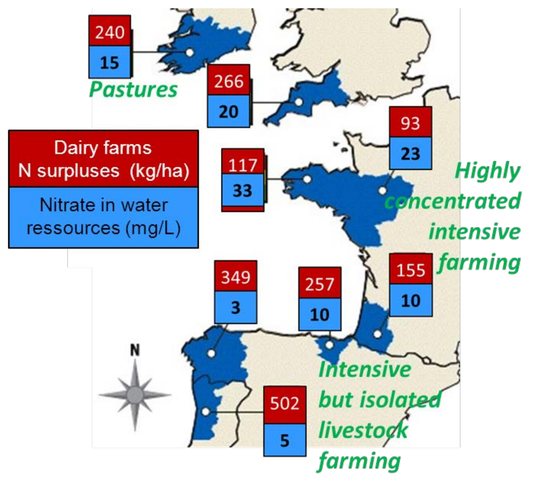
Efficiency	Drivers	Knowledge
Low *(10-40%)*	Production yields Feeding practices	++



Losses	Drivers	Knowledge
Very variable *(20-80%)* NH_3: *25-55%*	Housing > grazing Housing> spreading > storage Manure treatments	± Large uncertainty on emissions

➢ The impact of nitrogen losses also depends on landscape sensitivity.

That is the capacity of the agroecosystem and the environment (soils, surrounding ecosystems) to use or to transform the excess nitrogen. Local animal density, part of farmlands in the total of surfaces, rate of meadows... , influence nitrate and ammonia losses. This shows the need to better account for the territorial vulnerability when setting up environmental policies. Then, a critical load of nitrogen might be allowed for a territory whose amount depends on the local environmental sensitivity.

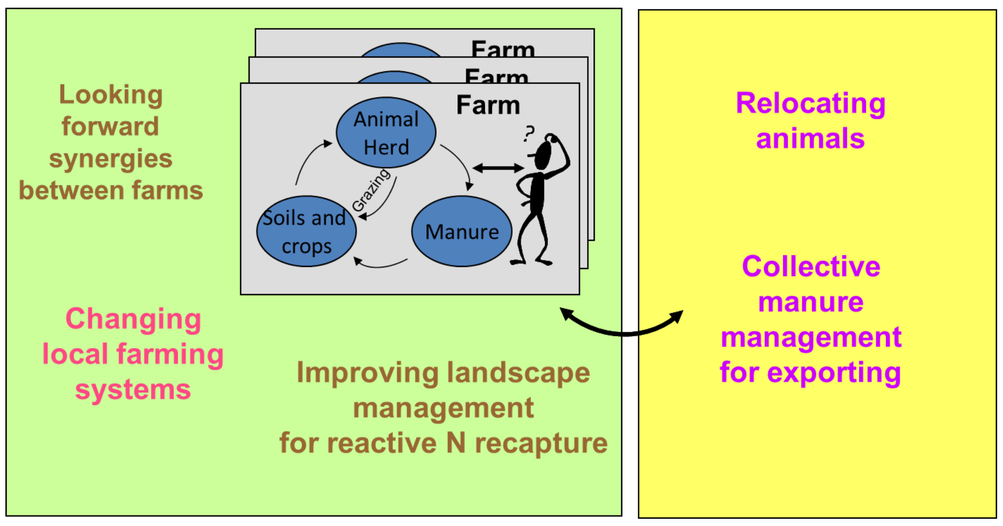


A range of options for reducing the impact of excess nitrogen in livestock farming has been defined:

- ❖ Applying more extensively measures for decreasing ammonia emissions, which has not been considered very thoroughly in France up to now.
- ❖ Manure treatment for exporting them to remote places with fewer nitrogen issues.
- ❖ Improving nitrogen balance on farm instead only in fields, considering thus all the flows and losses of nitrogen in the system. Yet it is difficult to implement due to the lack of data to estimate llocal flows.
- ❖ Relocating a fraction of livestock farms, or mixing crop and livestock systems could be envisaged on a case by case basis, between regions or between adjacent areas with different nitrogen loads. Inside critical areas, this might require reorganizing the farming systemmore dramatically. This can only be done with cooperation between local partners.
- ❖ Environmental policies face with the problem of the mostly diffuse sources of nitrogen sources and with the difficulty to give a precise value to most N-related damages. Penalties based on estimating nitrogen surplus seems to be the best compromise.

These options must consider interactions with other environmental issues (energy budget, phosphorus, pollution swapping) and economic issues (farmers income, global production).

➢ Territorial options and deals between areas



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