French report on integrated N emission abatement research & policy

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Outline

• **UMT GES-N2O** (Knowledge and management of N₂O emissions from cropland), project NO GAS (Measuring and modelling N₂O emissions from crops)

• **Project NO-GAS2**: towards a tier 2 approach for N₂O in France

• Deriving an **inventory of ammonia emission from crops** using a process-based model (~Tier 3 approach)

• **Esco elevage-Azote**: expert scientific assessment on N flow in livestock farming, including mitigation options.

• Ammonia: Lab system for assessing NH₃ emission potential
Unité Mixte Technologique (UMT)
« GES – N₂O »

« Improving the knowledge and the management of N₂O emissions by field crops »

2008-2013
What is a « Unité Mixte Technologique » (UMT) ?

- UMT is a new form of partnership, introduced by the French farming law n°2006-11, between research institutes and agricultural technical institutes (applied research).

- The objectives are:
  - To develop working relationships between research institutes and agricultural technical institutes,
  - In order to meet the needs of the stakeholders and the expectations of the society.
Towards a new UMT: CiclameN?

• Promote a global approach of N in field crops systems
• Trade-off / compromise between NO$_3^-$, NH$_3$ and N$_2$O
• Investigate options
  • Improvements when using mineral fertilizer
  • Legumes
  • Organic fertilizers
The NO-GAS2 project

Setting up a tier 2 approach for N₂O emissions from cropland

- Synthesis of available data, including the NO-GAS project datasets (but also data from other projects)
- Identify the relevant input data (drivers of N₂O emissions) for the Tier 2 methodology
- Identify the main (reliable) sources for the input data and data collection
- Statistical analysis for deriving a "Tier 2 formula"
- Application → N₂O emission inventory for cropland
NO GAS 2 – Available datasets

✓ Sources de données
- NO GAS : 68 years-treatments
- NitroEurope (main field): 4
- NitroEurope (satellite plots) : 6
- AgroParisTech farm : 25
- Longchamp (Burgundy) : 4
- Mons (Picardie) : 2

✓ NO GAS
- 9 sites
- 2-4 treatments per site
- 2 years (NO GAS project) : 2010-11 and 2011-12

A range of conditions
- Main crops : wheat, rapesed, maize, sugarbeet, sunflower, sojabean
- Met conditions : Rainfall: 300-700 mm; temperature 8-14°C
- Agricultural practices: ploughing, surface tillage, no till
- Soils : %clay 10-30%; SOM 1.5-4%; pH 6-8.2
- N input : 0-190 kg/ha/y
Input data
(reliable source, ± official)

Climate data:
   → Météo France

Soil data (texture, pH, SOM, ...)
   • BDAT
   • Donesol
   • RMQS
   → InfoSol (INRA) / GIS Sol

Agricultural practices
   • Agreste (Ministry of Agriculture)
   • Survey on «Pratiques Culturales»
   • Survey «Cultures» made by Technical Institutes
   • Database Epicles by InVivo
NO GAS 2 – Task 2 – NO GAS data analysis

<table>
<thead>
<tr>
<th>Model</th>
<th>Simple</th>
<th>Log_pH_MO Practices 1</th>
<th>Log_pH_MO Practices 2</th>
<th>Log_Ar_pH_MO Practices 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Texture T°c moy Pluvio moy Culture Type_culture Qté de Nmin</td>
<td>Texture pH MO T°c moy Pluvio moy Culture Type_culture Qté de Nmin Type_Wsol Norg Form_Norg</td>
<td>Texture pH MO T°c moy Pluvio moy Culture Type_précédent Qté de Nmin Type_Wsol Norg Type_Norg</td>
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<tr>
<td>AIC</td>
<td>438</td>
<td>395</td>
<td>356</td>
<td>342</td>
</tr>
</tbody>
</table>

\[ y_{ij} = \mu + \alpha_i + \beta_1 x_{ij} + e_{ij} \]  

End of the project by March 2014
Designing a level 3 inventory for ammonia emission from cropland in France, based on the VoltAir model

Database on meteorological data
Database on soil data
Database on land use / crops
Database on agric. Practices

\[ \text{Emission of NH}_3 \text{ in 1995 from France (tonnes of NH}_3) \]

\[ \rightarrow 2014 \]
Assessment of N flows in Livestock Farming Systems:

Main issues and proposed options

J.L. Peyraud, P. Cellier
with a group of 20 experts

(INRA, Univ., CNRS, Irstea, WUR, AAC)
A request from Ministry of Agriculture and Ministry of the Environment

- A synthesis of updated knowledge on N flows in livestock farming systems, from the animal to the regional scale, with a specific focus on farm level. This includes also historical analysis and economic issues (leading to livestock concentration …)

- All forms of N (nitrate, ammonia, nitrous oxide, others) and the link with impact had to be considered

- Identify possible actions to improve livestock farming systems sustainability (e.g. techniques, management, re-design of systems, economic and policy incentives)
N efficiency results from complex interactions, one improvement can be cancelled by a bad management at a previous or next stage.
Options to increase N efficiency at farm level

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Drivers</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 à 40%</td>
<td>Genetic merit (↑ eff) Feeding practices</td>
<td>++</td>
</tr>
</tbody>
</table>

Margins of progress +/-

![Herds Soils Crops Manure](image)

<table>
<thead>
<tr>
<th>Losses</th>
<th>Drivers</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 to 80% NH₃ 25-55%</td>
<td>Housing &gt; grazing &gt;spreading &gt;storage Treatments</td>
<td>Large uncertainty (emission)</td>
</tr>
</tbody>
</table>

Margins of progress ++

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<tr>
<td>Medium (&gt; 40%)</td>
<td>High inputs (↓ eff) Grassland, legumes, crop rotation</td>
<td>+</td>
</tr>
</tbody>
</table>

Margins of progress ++

*Take into account all N flows related to the farm to screen every source of waste and every way to progress*
Improving landscape management
(wetlands, grasslands, edges, small forests…)
(N use, denitrification, NH3 recapture)

Looking forward synergies between farms

Changing local farming systems

Relocating animals

Collective manure management for exporting
French expert assessment on N and livestock farming

• Direct/indirect important outputs:
  • Make people aware of NH$_3$ issues, esp. in livestock farming
  • Importance of having a global approach on N flows and budgets at farm scale
  • Need to consider larger scales, esp. for assessing the risks of N losses and the link with ecosystem sensitivity

• Documents on the web
  
  http://www.inra.fr/l_institut/expertise/expertises realisees/expertise_flux_d_azote_lies_aux_elevages
  • Summary : 8 pages (existing English version)
  • Extended summary : 67 pages (English version under progress)
  • Full report : 528 pages (includes the references; English version not planned)