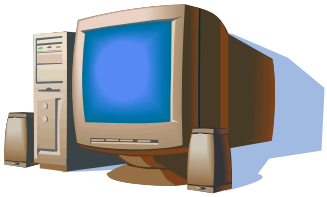
Designing a decision support system to assess nitrogen losses in cropping systems

V. Parnaudeau[1], R. Reau[1], P. Dubrulle[1], C. Aubert[2], A. Baillet[3], N. Beaudoin[1], P. Béguin[1*], F. Butler[6], P. Cannavo[1], J.-P. Cohan[4], A. Dupont[1], R. Duval[5], S. Espagnol[9], J.-P. Fagniez[1], F. Flénet[3], L. Fourrié[6], S. Génermont[1], L. Guichard[1], M.-H. Jeuffroy[1], E. Justes[1], F. Laurent[4], J.-M. Machet[1], F. Maupas[5], T. Morvan[1], S. Pellerin[1], C. Raison[7], C. Raynal[8], S. Recous[1], J. Thiard[1]

[1] INRA, Département Environnement et Agronomie, France, Virginie.Parnaudeau@rennes.inra.fr; [1*] INRA, Département SAD, France; [2] ITAVI, France; [3] CETIOM, France; [4] ARVALIS-Institut du végétal, France; [5] ITB, France; [6] ACTA, France; [7] Institut de l'élevage, France; [8] CTIFL, France ; [9] IFIP, France



Initial analysis

• The development of sustainable agriculture and of high environmental value farming systems relies on system diagnosis and design of innovative systems

• Nitrogen management requires improvement, on the basis of a **diagnosis of crop nitrogen use, losses and impacts, in diverse agricultural systems**

But:

• scientists did not always provide relevant tools to perform diagnosis and assessment, because they often neglected the constraints and requirements of stakeholders and advisers, the users of these tools

• few assessment and diagnosis tools are available for users at cropping system scale (Cannavo et al, 2008)

➔ a Decision Support System (DSS), called *Syst'N,* is currently being developed by French agricultural research and technical institutes in the "Azosystem" project, in order to assist N management in cropping systems, and **dedicated to environment stakeholders and agricultural advisers**

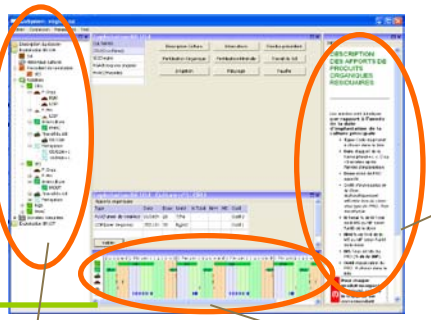
Design process

1. Survey by the possible users → specifications ➔ **various prototypes** of DSS interfaces proposed and discussed **between the designers**, and **proposed to a panel of potential users** - *collaboration with an ergonomist to organize the experimental device*

2. Design of the dynamic N model from exhaustive **bibliographical analysis** (Cannavo et al, 2008) and negociation among modellers

➔ decision to **build a new model, based on existing sub models adapted to the specific requirements of the users**

Description of the cropping systems in their context, with user data and default regional database



Notes helping the users to describe the cropping systems, soil and climate

Summarised description of the cropping system, enabling to copy, paste and modify them to analyse different situations

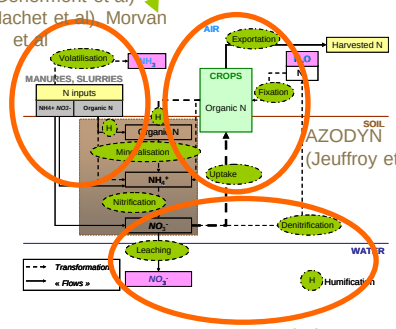
Scheme representing the cropping system being described, with every cropping operations

Input calculation for the simulator

e.g. Pedotransfer functions

Volt'air (Genermont et al)
AZOFERT(Machet et al), Morvan et al

Simulation of N fluxes at the rotation scale



AZODYN (Jeuffroy et al)

STICS (Brisson, Mary et al), NOE (Henault et al)

Scientific and technical challenges

• An interdisciplinary approach involving future DSS users

Taking account of knowledge and constraints of **researchers specialist of different areas**: cropping systems, environmental pollution at regional scale, N dynamics, modellers, and computer scientists

Collaborating with social science researchers to better **take account of future user requirements and knowledge**

• A reliable model functioning with available data of users

Some submodels such as slurry mineralisation, volatilisation and denitrification **modules have been adapted to require more simple input data than existing formalisms**.

"adaptation" = finding statistical relationships instead of developing mechanistic equations, to better take account of local pedoclimatic conditions.

• Towards a realistic diagnostic tool

Necessary **to include the crop yield as an input** to better predict crop growth and N uptake, in order to precise soil mineral N at autumn and consequently N leaching (Makowski *et al.*). This requirement is being studied from the point of view of the computer scientists to **assess the scientific and technical feasibility of this formalism.**

Until now, the graphical interface for inputs and the simulator have been implemented. The ongoing step is the **test and assessment of the whole model with external datasets**. Another step is the adaptation of the N model to cropping systems including grasslands or vegetable crops. At the same time, the graphical interface giving some views of output data (tables or graphics) will be designed and developed.

The design process will continue, by **associating stakeholders in the improvement of the DSS through a learning loop**, and we will **develop a learning activity** with advisers in order to improve assessment of N losses and to enable the use of simulation and virtual experimentation.

References: Cannavo P. et al. (2008) Modeling N dynamics to assess environmental impacts of cropped soils. Advances in Agronomy, vol. 97:131-174 ; **Makowski et al.** Measuring the accuracy of agro-environmental indicators. Journal of Environmental Management*, in press.* ; **Parnaudeau V., et al.** (2007). A Sociological Approach to Determine the Advisers and Stakeholders Requirements for Nitrogen Management and Diagnosis Tools. 15th European N workshop, Lleida (Espagne) Mai 2007.

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