

Modelling manure NPK flows in organic farming systems to minimise nitrate leaching, NH₃ volatilization and NO₂ emissions (OF0197)

Funder: DEFRA
Collaborators: IOR-EFRC, ADAS
Start Date & Duration: 2000-2002

Overall Aim

Environmentally damaging emissions of N arise from agriculture: ammonia, nitrous oxide and nitrate. Losses can be altered by changed management practices; such practices also affect the interaction between the three loss pathways. There is a need to make farmers aware of the size of the N losses and the effects of management practices. This is particularly pertinent to organic farmers, where N can be limiting to some crop production. Consequently a tool to identify the fate of N (and PK) from manure could assist in developing more environmentally friendly practices that also increase crop productivity and soil fertility. Phosphorus loss from agriculture is another environmental issue that needs addressing.

This project fits within the EFRC objectives to optimise the use of renewable resources within a closed farming system, whilst maintaining soil fertility and avoiding pollution.

Objectives

1. Establish a Farmer Focus Group (FFG) and define template organic livestock and manure management systems representative of existing farm management practices;
2. Compile a database on livestock excreta characteristics and rates of production, for the range of stock type and age classes identified in the systems above (1);
3. Extend the MANNER (MANure Nitrogen Evaluation Routine) model for the estimation of nitrous-oxide emissions following manure spreading, in addition to existing calculations of ammonia emissions and nitrate leaching;
4. Develop a model of nitrous-oxide and ammonia emissions from livestock units and manure storage systems, expressing emissions as a percentage of the total ammonium and uric acid nitrogen (TAN) content of the manure, on a monthly time-step;
5. Compile a database on nitrous-oxide and ammonia emission rates for each type of existing livestock housing, and manure collection and storage system, for use with the model developed above (4);
6. Develop a prototype of the decision support software, and refine the technical specification and scope of the system following user-testing by the FFG;
7. Develop final version of the decision support software and compile technical documentation;
8. Demonstrate the application of software to representative organic livestock systems, and evaluate the potential for technology transfer.

Project Progress

Objectives 1 to 7 have been completed. The project was delayed in 2001 as the modellers employed by ADAS to develop the software were diverted on to FMD work. Post FMD there were problems in re-appointing a suitable programmer to complete the project.

In presenting the decision support software to organic advisers a number of refinements were suggested and this has further delayed the final objective.

Expected Benefits

The benefits derived from this project is to demonstrate options for improved manure management on organic livestock systems, for the reduction of nitrogen emissions (ammonia and nitrous oxide) and nitrate leaching, and the maximisation of the fertiliser value of the manure NPK content without exceeding the 170 kg N ha set out in the organic standards.

This will be achieved by the development of computer software that will integrate nitrogen flux models with an interactive interface for the definition of the farm environment, including stock management and manure storage systems, and the timing of spreading of manure to agricultural land.

The software will calculate N (and PK) fluxes associated with each aspect of the livestock system and provide options to explore the impact of management change at key stages in the manure nitrogen cycle.