

An internet-based tool for use in assessing the likely effect of intensification on losses of nitrogen to the environment

N.J. Hutchings, B.M. Petersen, I.S. Kristensen, N. Detlefsen and M.S. Jørgensen

Dept. of Agroecology, Danish Institute of Agricultural Sciences, Research Centre Foulum, P.O. Box 50, 8830 Tjele, Denmark, Email: nick.hutchings@agrsci.dk

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Introduction The EU Nitrates, Habitat and National Emissions Ceilings directives and the Kyoto Agreement mean that agricultural losses of NO₃, NH₃ and N₂O are under scrutiny by national and international environmental authorities. When farmers wish to intensify their operations, the authorities must then assess the likely environmental impact of the change in operation. The FARM-N internet tool was developed to help farmers and authorities agree how the farm will be structured and managed in the future, and to provide an objective assessment of the environmental losses that will result.

Methods The farmer must describe the current and proposed farm structures and management, in terms of the number and type of livestock to be kept, the animal housing and manure storage facilities to be used, the land that will be available to the farm and details of field management. The latter include the crop rotation and type of manure spreading equipment to be used. For ruminant livestock farms, the production of milk and livestock has to be consistent with the animal feeding practice, the choice and productivity of the crops chosen, the sale of crop products and the amount of additional animal feed imported. To assist in this process, the tool contains two models. The first is based on a series of decision rules and enable an agronomically-sensible crop rotation(s) to be constructed, based on an input combination of crop type and area planted. It then determines the applications of manure and mineral fertiliser that should be applied to each crop, dependent on the amount and quality of manure that is available. The amount and quality of manure is, at this stage, assumed to be equal to the standard values in the Danish nutrient management regulations. The second model predicts N excretion from livestock, N losses from animal housing, manure storage and fields and crop responses to N inputs. In situations where livestock are partly fed on home-grown products, there is a closed cycle between crop production and protein content, N excretion by the livestock, N losses in animal housing, storage and after manure spreading and the N available to the crop. This means that these models have to be used iteratively until a consistent N flow is achieved. References to the models used in the FARM-N tool can be found on www.farm-n.dk.

The tool calculates a farm N balance and uses relatively simple models to partition this balance between ammonia emissions from animal housing, manure storage and field application, nitrous oxide and dinitrogen losses, nitrate leaching and changes in the soil N. The results are presented in the form of a simple table. The tool can store a number of future farm structure and management scenarios, enabling the farmer and environmental case officer to explore different structural and management options.

Discussion Discussions with target users indicate that they are satisfied with the technical aspects of the tool but disagree amongst themselves concerning the role of soil C and N in the future scenarios. Under Danish conditions, both the models and monitoring (Heidmann *et al.*, 2001) suggest that there is an accumulation of C and N in the soil of grassland farms. This is thought to be because most Danish farms were mixed livestock/arable until 30-40 years ago and the soils are still adjusting to the higher inputs and larger contribution of grassland to the crop rotation. The disagreements relate to whether this accumulated C and N should be considered semi-permanent storage or a large source of N that could be lost to the environment, should management practices change.

Reference

Heidmann, T., J. Nielsen, S.E. Olesen, B.T. Christensen & H.S. Østergaard (2001). [Changes in the C and N content of cultivated soils: Results from the soil sampling grid 1987-1998] (in Danish). Danish Institute of Agricultural Sciences Report no. 54, 73 pp.