Environmental assessment of oilseed rape cropping systems

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ABSTRACT

The sustainability of cropping systems on the farm level has been analysed with the computer model REPRO. With this model, which has been developed at the Institute of Agronomy and Crop Science at Halle-University, it is possible to quantify the effect of different cropping systems on the agronomic, economic and ecological performance on the farm level. This encompasses all energy and material flows as well as the impact of husbandry on biodiversity. Together with information about the economic consequences of changes in husbandry, fertilizer use or pesticide application, farmers are thus able to optimise their systems for multiple goals. The REPRO system already includes a very detailed documentation of the production process, which is also necessary for an assessment on the food chain level of oilseed rape. Additional information, which is required for retailers, include a number a quality features and information on the processing level. In a last step, thresholds and target values of the different indicators in this system have to be fixed based on a discussion process between the different groups that participate in the entire production process. A prerequisite for such a procedure from data collection to target value definition is sound information about the current situation of a food chain, detail documentation and transparent threshold definition.

Key words: Sustainability, environmental assessment, cropping systems

INTRODUCTION

The concept of sustainable development integrates economic, ecological and social aspects. Up to now, the consequences of sustainable development have been discussed mainly on the level of definitions, however, limited attention has been placed on the challenge to look simultaneously at the food chain for different products (Christen 1999). For clarification it is important to classify the different approaches for the assessment of sustainability according to the following categories (Christen 1999, Christen and Christen O'Halloran-Wietholz 2002)

- Scale of observation (regional, field, rotation and / or farm level)
- Purpose of the indicator system (optimisation at field, farm or regional level, administration, control, marketing)
- Model bases (description of farm-internal material and energy flows with interactions between different cultivation practices and / or farming system components)
- Regional references (master data or modelling)
- Transparency of evaluation and aggregation processes
- Cost of data acquisition
- Practical handling (PC solution or internet-based solution)

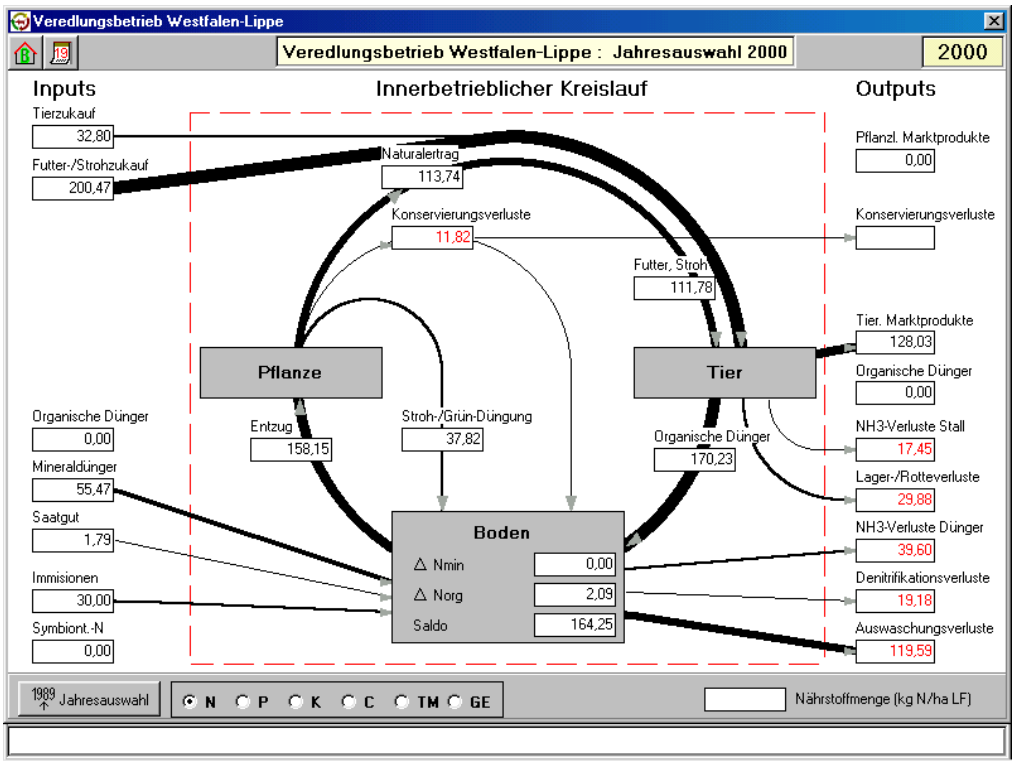
Most assessments systems of environmental effects of agriculture systems lack a precise categorisation according to the criteria cited above. If an indicatorsystem is used for the optimisation on the farm level, the consideration of the interactions between indicators is a crucial point. One example might explain the relevance: In case the indicator "nitrogen balance" gives a high positive result, the consequences of such a finding without interactions would be to apply less nitrogen. This might be a completely inadequate conclusion because a high positive nitrogen balance might well be caused by a suboptimal application of pesticides and a low yield for that reason. The consequence in this case would be not to decrease the nitrogen fertilization, but to improve the pesticide management. An indicatorsystem designed to control or to administer payments etc. might be very simple and complex considerations like interactions between single indicators seem to be unimportant, although conclusions might be wrong. If, however, the optimisation of husbandry, fertilizer or pesticide management on the farm level is the target, those interactions must be considered.

MATERIALS AND METHODS

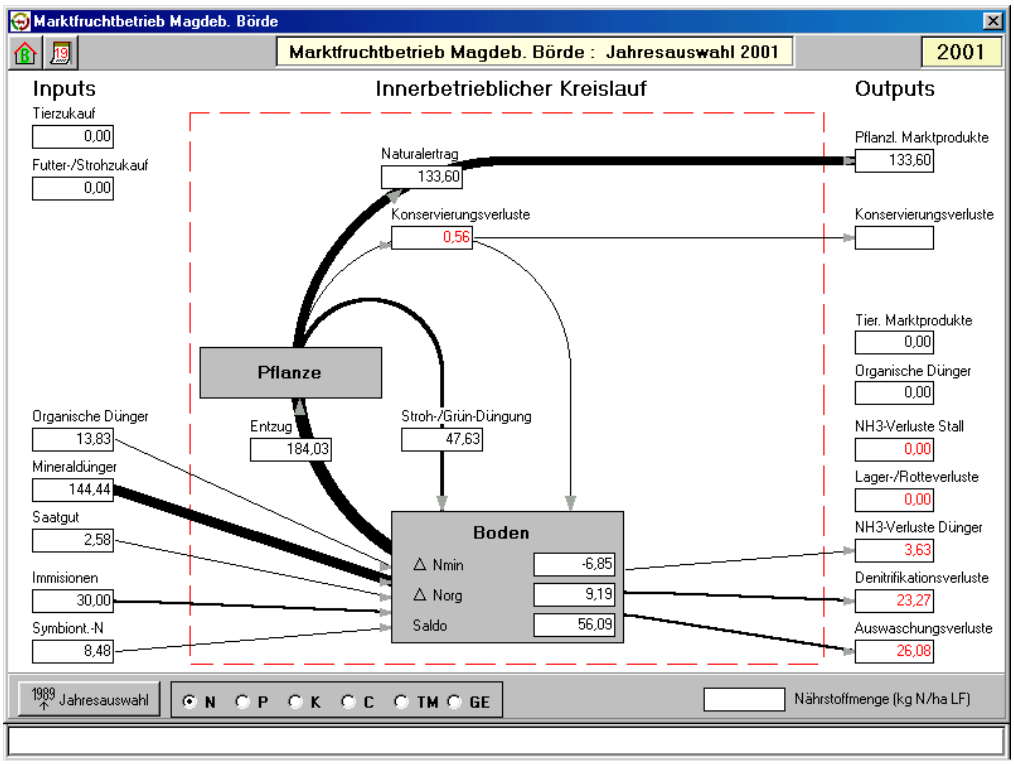
The computer model REPRO has been developed at the Institute of Agronomy and Crop Science, University of Halle-Wittenberg, Germany. The model uses data, which is available on the farm level like yields, use of machinery, pesticide applications etc. Based upon data from long-term field trials and master data it is thus possible to calculate a number of ecologic and economic indicators relevant for the assessment of the agricultural enterprise (details in: Kalk et al. 1998, Hülsbergen et al. 2001, Heyer et al.). Another important feature of REPRO, different to most other indicatorsystems, is the site specific assessment of the farm. REPRO has been used extensively in a range of scientific projects and in the extension service in a number of different parts of Germany on a whole of more than 150 farms. Currently REPRO is used in a number of projects in the German states Saxony and Saxony-Anhalt REPRO to assess the effects of agri-environmental programs. Currently REPRO is only available in German but an English version will be available at the end of 2003.

RESULTS AND DISCUSSION

Two example of the visualisation of results is given in the screen-shot on this page. It shows the entire nitrogen flows on the farm level for two different farming situations. In the first example a farm with fairly extensive animal production is shown. Most Input in the nitrogen cycle derives from purchased fodder. The nitrogen leaching losses are quite high with almost 120 kgN/a.



The second example is based upon a farm without animals. The nitrogen in this system derives almost exclusively on purchased nitrogen fertilizers. Due to the high yields in relation to the nitrogen input, the nitrogen balance is much lower with less harmful impact on the environment.



The following challenges have been encountered during the project:

- The aggregation of different indicators has to be considered only very carefully. An aggregation might imply cause-effect relations between indicators which are not existing in reality.
- It is difficult to find an appropriate system to compare the system of oilseed rape growing with.
- The definition of thresholds requires a discussion, since any sort of thresholds as includes intrinsically values of different kinds. With our experience based on a number of projects, we recommend to discuss thresholds with all relevant partners in politics, administration, farmers union, scientists and environmental groups.

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