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Product Flow Modeling: tailor-made decision support for farmers

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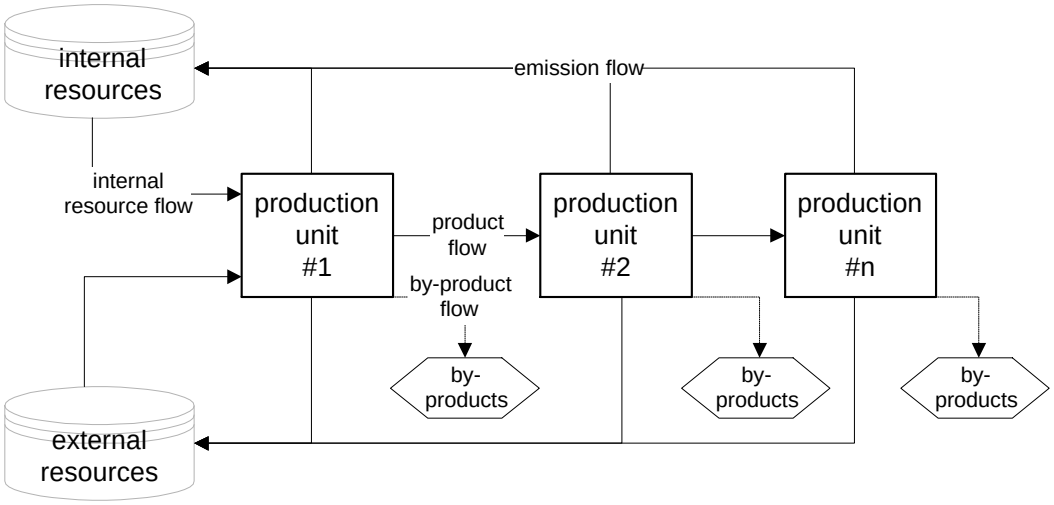
Introduction

This short communication describes a (Ph.D.-)project in progress that deals with developing new concepts for supporting whole farm management and must result in a prototype decision support system (Wolfert *et al.*, 1996). The focus is on mixed (integration of crop and animal production) organic farming. In contrast with specialized farming, mixed farming links many processes in order to produce several end products; often these processes also have a cyclic character. Management of organic farming systems is based on control of complex, dynamic ecological processes and, in contrast with conventional farming, an organic farmer has no quick-acting instruments like fertilizers, pesticides, etc. to his disposal, but has to rely on more complex, often long-term ones.
At the moment there are not yet many systems that support whole farm management, but usually one or few aspects are supported (e.g. specific disease management, financial or nutrient management). Furthermore these systems were usually developed for specialized, conventional farming, so they will probably not account for the aforementioned basics of mixed organic farming. Hence a new approach, called *product flow modeling* (Udink ten Cate *et al.*, 1994), was taken and further developed and will be briefly described in the following section.

Methodology



The followed methodology can be divided in three steps:

1. *product flow instantiation* – the generic product flow model, that is shown above, is filled in for a specific farm. The whole farm is split up into production units between which products (e.g. silage feed, manure) flow and finally end products (e.g. milk, potatoes) flow to external resources that are markets. Internal and (in less proportion) external resources form the basis for production. Emission flows restore internal resources, but must not exceed certain limits to prevent from pollution. Beside physical components, by-products are defined as immaterial side-effects of production (e.g. animal welfare, labor conditions).
2. *sustainability mapping* – sustainability for the specific farm is defined in terms of goals or indicators. This is supported by multi-faceted structured entity modeling.
3. *process informatics development* – sustainability goals are connected with the product flow model. This means that units and flows get properties (e.g. nitrogen contents, prices, welfare scores, etc.) attached that are aggregated and/or integrated so that goals can be evaluated properly.

The result of these steps is combined in one software system that provides the right environment, with different structured views on the real farming system, that enables the farmer to optimize decision-making. This means that critical success factors and accompanying relations must be identified. The next step to describe per process (sowing, plowing, milking, etc.) how these factors and relations can be positively influenced. This results in a farm management handbook that is farm- and farmer-specific.
Furthermore it is possible to develop a farm-specific simulation model that enables the farmer to carry out *what-if analyses*, although one should be very careful with this because of the unpredictable influences and complex ecological relationships that are involved.

In this project a first prototype will be developed for the APMinderhoudhoeve, an experimental farm of Wageningen University and Research Center. At the moment step 2 is almost finished.

Conclusions and potentials

The described approach is in the first place meant for on-farm research by the farmer himself. The software system provides a basis for theoretical ‘thought’ experiments and also a good environment for setup and evaluation of practical experiments and how feedback to management could take place.
For farm management it is mostly enough to identify and work with black-box-relationships. However, because the system registers many data about the farm and its management, it could be used for scientific research to clarify biological mechanisms. Then this knowledge can indirectly be used in farm management; a deductive approach.
Another possibility is that these data are exchanged with other farmers and discussed in for example study groups. Because data is available in electronic format, internet could play an important role in this.

References

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