Towards a Better Balance of Forage Supply and Demand

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Task 3.4 seeks to develop a decision support system (DSS) – a software – that supports farmers and their consultants to evaluate measures in terms of their ability to reduce risks of feed shortages on low input dairy farms – both organic and conventional.

Although a generally recognised definition does not exist of what a “low-input” dairying business exactly is, it is widely accepted that most farms of this type feed a considerably higher share of forages grown on-farm and less concentrates. The herd's requirements must be met to a large extent by grazing, conserved fodder from permanent grassland or forages from arable land. Therefore a low-input dairy farm has less options to supplement - and in case of shortages: substitute – forages with purchased feedstuffs. The risk of weather induced on-farm forage shortages is of greater importance in a low-input dairy farm, and feed supply and price volatility is less evened out by markets. The DSS models scenarios to help farmers

The DSS will evaluate measures to help to reduce risks of feed shortages – both in terms of dry matter and nutrient supply. The major components of such a system are requirement (herd), supply (feedstuff) and a logic that connects both sides (rations).
The mathematical models and algorithms include a model to simulate the herd structure with different calving patterns (no. of dry and milking cows, heifers, young stock, days in milk etc.). This model will feed the algorithms that estimate feed requirement (dry matter, energy and protein).
The supply side is estimated via a grassland (pure grass or grass-clover swards) model which simulates forage growth and quality throughout the year. Later it will be extended with other crop models. A soil model will cover the most important dynamics of water and nitrogen availability.
The models of the demand and supply side are connected with a ration formulation routine (linear programme) that designs the rations in a way that both over- and undersupply is minimized for energy and protein across all animal groups throughout all periods.

The major challenges are:

• to find a reasonable balance between minimizing the need for the user to enter data (usability) and model output quality.
• to compromise between an implementation of the many different feed evaluation systems which are used throughout Europe and an oversimplified single evaluation system (a sort of common denominator).
• to design a useful method to describe the risk of feed shortages in order to evaluate management options.
• to narrow down and prioritize all possible management options that could be evaluated by the DSS.

It is apparent that the approach must be reduced to a certain extent in both scope and precision. It is not possible to design and parameterize a very complex DSS model that could be used in any low-input dairy farm in Europe. We try to cope with those problems by pursuing a strategy that allows us to continuously, iteratively develop sub-models and test their interaction without prior precise knowledge of all potential sets of decision questions.

A range of questions that could in theory be evaluated by the software are presented here. Basically there are three possible areas of intervention to reduce the risk of a feed shortage:

- A reduction on the demand side
- An increase on the supply side
- A better balance of demand and supply

All measures within these areas shall be evaluated against the status quo and an indicator will be derived which reflects the risk a farmer is currently willing to accept (e.g. in x out of n years the supply is not sufficient to satisfy herd requirement).

Since the software will not be able to predict e.g. harvest dates and yields exactly, all management options should be evaluated in terms of their probability to lower the risks: How much would an improvement in management towards an ideal situation reduce the risk of forage undersupply? How sensitive is a certain option with respect to the overall goal?
If one assumes that it is not possible to manage everything in an ideal manner (pick the optimum harvest date plus pick the optimum grazing day plus have an ideal herd structure etc.) it could be helpful to evaluate how much an 'investment' (spending management resources, gaining knowledge, improving technology) in a certain improvement would pay off.

Reduction of the demand
A reduction of the demand side can be achieved by altering the herd structure, e.g. changing the number, breed and production potential of cows, or keeping cows longer to reduce the proportion of non-producing heifers.

Increase of the supply
Increasing the area of forage production (either by acquiring additional land, substituting cash crops with forages or grow intermediate crops) is the most trivial decision one can think of. A proper decision question might be "which forages should be grown on additional land to minimize the required area?"

Feed allocation and balancing of demand and supply
A third area of questions potentially supported by the DSS are concerned with a better allocation of feedstuffs. The reduction of waste due to improper rations might be an important way to achieve better food security: "How does grouping of animals affect feed allocation and reduction of wasted nutrients? Does variability of requirements within the herd make a huge difference? What is the optimal supplementation of available forages?".