Using decision support tool for dairy farm management to assess the economic impact of various feeding scenarios

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Abstract
This paper describes the computer implementation of the decision-making support for dairy operation management. It also aims to improve interpreting the potential impacts of different management decisions on key variables as well as trade-offs, which influence decisions taken at the farm and the feed component level. A baseline, potential management decision scenarios were evaluated and compared as alternative ways of managing the feed requirements of dairy operation. The web-based application EkonMOD milk tool was used to examine the relevant association on the farm-level and to calculate the economic consequences. The purpose of the EkonMOD milk application is to assist dairy farms managers and to better understand the dynamics of the dairy herd structure and to improve economically sensible decision-making abilities in Slovak conditions. Feed requirements accounts for 40 % to 70 % of the cost of raising replacement heifers and is generally the greatest expense for milk production. There are several key decision-making levels related to calculating of income over feed cost (IOFC). In order to make this process user friendly, a web-based tool will calculate actual feed costs and amount of feeds per cow per day, daily income from one cow, concentrate feed used to produce 1 kg of milk, yearly IOFC, and allow the comparison. The sensitivity analysis will identify the uncoordinated one in terms of economic returns and key production impacts. The study's findings contribute to the understanding of animal production management routines and consequent economic impacts on dairy operation.

Keywords: dairy, management, feed costs, IOFC, decision tool

JEL Classification: Q120

Introduction
Optimal feeding strategies related to the unique herd specification represent the key role in efficient and profitable dairy operations. Important daily management agenda connected to profitability of dairy operation is feed ingredients and feed costs optimization. Feeding costs are generally the greatest expense for milk production in dairy farms. The most of the producers are typically focused on increasing total milk production, because this reflects in increased total milk incomes for farmer. With volatility in feed and milk markets, income over feed cost (IOFC) is a more advantageous measure of profit than simply feed cost per cow (Buza, 2014). According to Wolf (2010) the IOFC can include gross milk income and feed cost to better monitor profit. This approach to the farm profitability benchmarking simply quantifies the difference between the amount of income from marketed milk and feed costs, including both, home-raised and purchased feeds. As reported by (Bozic et al., 2012) the profit margin management can be done by monitoring IOFC. It can be also used as a feeding strategy evaluator, with the determination of economic impact on the farm profitability in the context of the current level of milk output sales. As stated by (Vibart et al., 2012) the IOFC can be used as a measure of feeding implementation level in dairy operations. The IOFC tool, as a benchmarking method, is not commonly used in Slovakia.
In this paper we reflect on our experiences in developing and delivering management decision tool for dairy farmers in Slovak conditions. The effect of various ration composition and related costs was evaluated.

**Data and Methods**

The application EkonMOD milk, the decision support tool concept for dairy farm managements is used to evaluate the economic consequences of different on-farm feeding strategies. The selected module Yearly milk income over feed costs was developed to raise the awareness about feeding costs related to the milk production and it is used in this paper as a tool to evaluate specific economic and production parameters of a user specified dairy operation. EkonMOD milk is developed in SAP Business Objects Dashboards (version 4.1) and was developed by National agricultural and food centre in Nitra. The core of the application consists of a main Microsoft Excel input and output worksheet, containing basic algorithms and formulas for computing selected farm specific economic and performance outputs. The interactive dashboards are used to illustrate the impact dynamics of the changed variables and they represent the visual add-on to the Excel core application. The tool combines inputs and transforms then into information source - output for farmer by operative construction of economic a production model from individual farm data. Yearly milk income over feed costs will be calculated by EkonMOD milk using following herd specific input metrics: price per ton and daily amounts of all feed components used at the dairy farm, number of dairy cows, total daily milk production and milk price. The application will calculate actual feed costs (FC) and amount of feeds (AF) per cow per day, daily income from one cow (DI), concentrate feed (CF) used to produce 1 kg of milk, roughage costs (RC) per kg of milk produced, concentrate and additional feed costs (CAC) used per kg of milk produced, and allow the comparison between different feeding scenarios, by calculating yearly income over feed costs (IOFC). The yearly IOFC represents the difference between total milk revenues and feed costs during one year period (1).

\[ \text{IOFC (€)} = \text{MP} \times \text{TMP} - \text{TFC} \]  

where:

MP is the average milk price  
TMP is the total milk production (year)  
TFC is feedstuff costs required to produce the amount of milk reflected in TMP

The feeding costs are not divided into home-raised and purchased in this model. The calculations give the overall view on the dairy farm, in terms of benchmarking the feed ration to the income per year. However, some producer may not be aware of what the costs of home-raised feed exactly are. In this case, the EkonMod milk tool web site offer the information about the latest developments in the market prices and other relevant updates for dairy farmers.

**Results and Discussion**

Feed costs are directly linked to the milk production. However, milk production focusing on output maximization in not necessarily linked to the profit of dairy operation. Another important issue is
knowing the difference between the IOFC calculation on the cow and herd level. The individual cow milk-yield basis gives not the accurate view on the farm economics. The sick and non-lactating cows represent the hidden costs, which are typically excluded when computing IOFC per cow. However, these cows need to be fed and in addition to this, they do not generate any income from milk. Calculation IOFC on a herd level will ensure a broader perspective on the financial condition and productivity from given amount of feed inputs. The input section of the EkonMod milk tool can be seen in Figure 1. The user specifies the daily amounts of roughage feeds, concentrate feeds and additional feeds, respecting the relevant subcategories in the first scenario. The user-friendly format, developed during the consultancy with farmer improves the communication interface, and allows to incorporate any change by simple slides with bars for every input used.

**Figure 1: EkonMOD milk model calibration**

![EkonMOD milk model calibration](source)

Source: EkonMOD milk screenshot, section for inserting farm specific inputs

The first milk incomes scenario from 127 dairy cows reached 100 912 € in this model. The daily milk production amounted 1860 kg of milk, with the milk-yield 14.6 kg per cow. The price level for milk shipments was set to 26.94 € for 100 kg of milk. The share of feed costs on total incomes from milk totaled 45 %. The result of IOFC calculations from given inputs in first scenario can be seen in figure 2.

**Figure 2: Results of the IOFC calculation (scenario 1)**

![Results of the IOFC calculation (scenario 1)](source)

Source: EkonMOD milk screenshot, section computed IOFC.
Note: Total number of dairy cows, daily milk production and milk price indicators are adjustable by the user

The system of illustrative dashboards of the EkonMod milk tool can be seen in figure 3. These dynamic indicator represent the information base for sensible decision-making of dairy operation feed management. The values in the dashboards reflect the inserted data form input section of the EkonMOD milk tool.
Figure 3: Dynamic dashboards of the EkonMOD milk tool (scenario 1)

Source: EkonMOD milk screenshot, section with dashboards containing computed results for farmer

Increased daily milk production (shipments +230 kg), increased feed costs and amount of feed per cow per day (+ 0.28 € and 4 kg), increased concentrate and additional feeds to produce 1 kg of milk (+ 1 €/cent), decreased roughage cost per kg of milk produced (-0.6 €/cent), increased daily milk income from one cow with 16.5 kg milk yield (0.15 €/cent and 1.9 milk yield) and increased share of feed cost on total incomes from milk (+5 %) led to the overall decrease in yearly milk income over feed cost by 5928 € in scenario 2. The graphical interpretation of this alternative management approach to milk production can be seen in figure 4.

Figure 4: Dynamic dashboards of the EkonMOD milk tool (scenario 2)

Source: EkonMOD milk screenshot, section with dashboards containing computed results for farmer

Conclusion
The key factor when considering IOFC is to revise the calculation when unexpected changes in milk and feedstuffs prices occur, or new potential management decision has to be evaluated first. Another important characteristics of this approach is different pricing of inputs between dairy operations in comparisons. Despite this limitation, the IOFC tool is confirmed to be a viable source of information for dairy farm managers in combating the price volatility on the markets and could be vital in creating benchmarks against the goals of the farm itself. The EkonMOD milk tool does not link to fertility and health issues. However, the simulation of the effects of changed fertility and other issues could be implemented in the future work by using linear and dynamic programming, hierarchic Markov processes, Bayesian networks and influence diagrams. At the current state of development, the EkonMOD milk tool evaluates the risk associated with changes.
in milk prices and ration costs, however, as the model simulates only a one year period, risk aspects related to the management throughout the years cannot be considered. The concept of communication with farmer is open to joint research team to bring relevant and diverse expertise into this decision support tool in Slovak conditions. These experiences are vital for future research and development activities in the field of dairy production in Slovakia.

References


