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Automatic feeding systems (AFS) – potential for optimisation in dairy farming

A survey carried out on farms in Denmark, Germany, the Netherlands and Switzerland indicates current trends in cattle feeding. The survey indicates that automatic feeding systems ease the workload of dairy farmers, save time, and increase flexibility. The investigated farms differ both in the number of feed rations and feed components. The working time, required by the automatic feeding systems (AFS), depends mainly on the time for feed handling, such as the used collection technology, the type and distance to the feed storage. In some systems feed pushing can be omitted completely.

Keywords
Conveyor belt, rail-guided feeding systems, working-time

Abstract:
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Feeding without a fully automatic feeding system accounts for approximately 25 % of total working time requirement. After milking, this corresponds to the most working time in dairy farming [1]. State-of-the-art feeding technology allows the automatic distribution of basic ration or a mixed basic and fodder concentrate ration using conveyor belts, rail-guided or self-propelled feed robots. The manufacturers claim that automatic feeding makes for a significant easing of the workload, better feeding hygiene and less feed loss. A survey on this was conducted on farms with automatic feeding, and working time measurements were taken. The aim was to show which systems were available on the market and whether they came up to expectation.

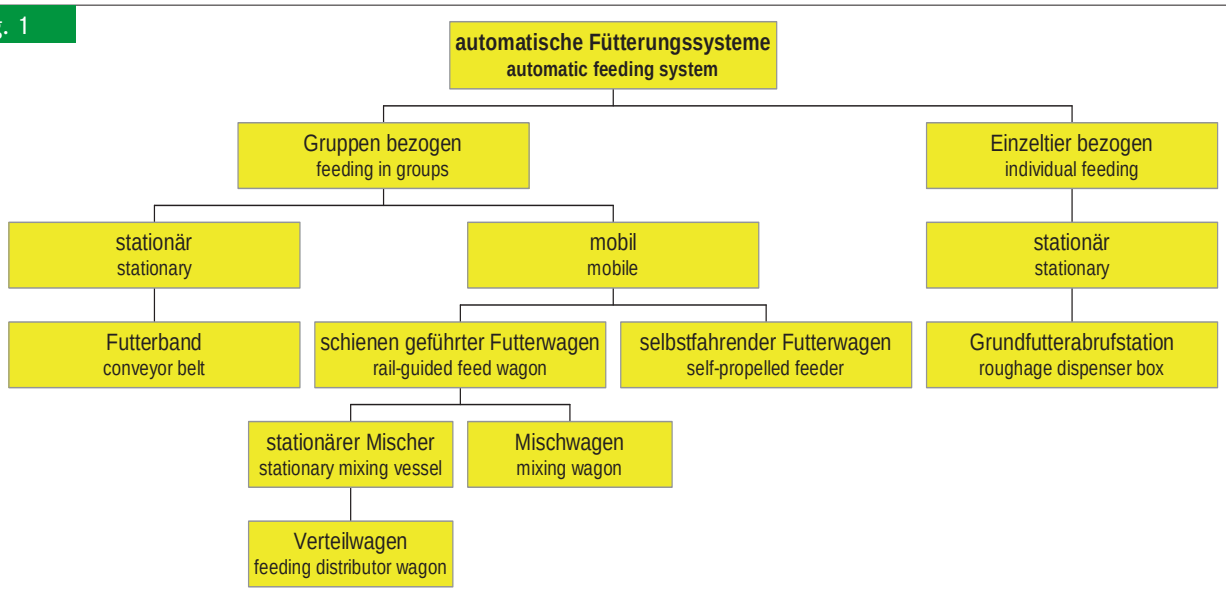
How automatic feeding systems work

In automatic feeding the interaction of individual elements is important, from feed store to feeding table. There are therefore various technical approaches to AFS (**figure 1**). These include stationary systems such as conveyor belts, and mobile systems such as self-propelled or rail-guided feeder-mixer wagons. An exact description of the systems was given in ART Report 710 [2].

Field survey procedure

The collection of data on state-of-the-art automatic feed distribution took place on 18 dairy farms in Denmark, Germany, the Netherlands and Switzerland. The farms (numbers in brackets) with AFS were selected in collaboration with the companies Cormall (3), DeLaval (2), Mullerup (5), Pellon (1), Rovibec (4) and Trioliet (3). The farmers provided information on farm structure and mechanisation in a structured interview. Data was gathered on the areas of feed distribution, feed storage,

Fig. 1



Concepts of automatic feeding systems

feed mechanisation, integration in buildings, motivation for AFS use and experience and impact of AFS.

Working time measurement procedure

The recording of working time data was carried out at task element level in the form of direct measurements taken while observing work on four farms in Germany with rail-guided AFS. Time measurement was effected by means of Pocket-PC and time recording software. The data were entered on a planned-time data base, statistically analysed and incorporated in the PROOF model calculation system [1].

The working time requirement for two farm variants (60 and 120 animals) was then modelled. The model was based on the following assumptions:

- Daily silage removal and feed table cleaning for a feeder-mixer wagon and rail-guided AFS
- Feeder-mixer wagon capacity: 14 m3
- When feeding with AFS the herd was split into two lactating groups, no groups were created for the feeder-mixer wagon
- For feed distribution with a feeder-mixer wagon the feed was pushed three times a day, this work did not apply with an AFS
- Ration adjustment programming for AFS was carried out once a week, twice a year for the feeder-mixer wagon
- The ration consisted of five basic fodder components

Survey results

The herd size of the farms visited was between 28 and 390 dairy cows, the utilised agricultural area between 18 and 640 hectares and the average milk yield between 8,000 and 9,000 kilograms per year. Two Swiss farms with AFS kept their cattle in tied housing.

According to the survey the maximum number of feed distributions was between 2 and 13 per day. Most of the farms distributed fresh feed 8 times a day and automatically fed up to 10 feed components. Grass and maize silage was most frequently used in the rations, followed by hay and soya.

Grass and maize silage was stored predominantly in a horizontal silo, hay and straw as square bales. Before AFS was installed seven of the 18 farms already fed a total mixed ration with a milling cutter mixer wagon or feeder-mixer wagon.

On six farms the first feed distribution took place between 3 am and 5 am and on eight farms between 6 am and 7 am. Four farms provided no information on this count. The last feeding time was between 5 pm and 2 am. Eight farms distributed the final ration to the animals between 9 pm and 10 pm. Only one farm provided feed throughout the night.

14 of the 18 farms said that the main reason for having an AFS was to reduce workload and save time. Reasons connected with cowshed construction also led to the installation of an AFS. Building costs can be saved here, due to the narrower design of feeding tables (up to less than 2 metres) in new buildings. In old buildings the space gained as part of reorganisation often served as an extended traffic area or lying area. Other factors mentioned were increased flexibility in labour planning and more precise herd feeding.

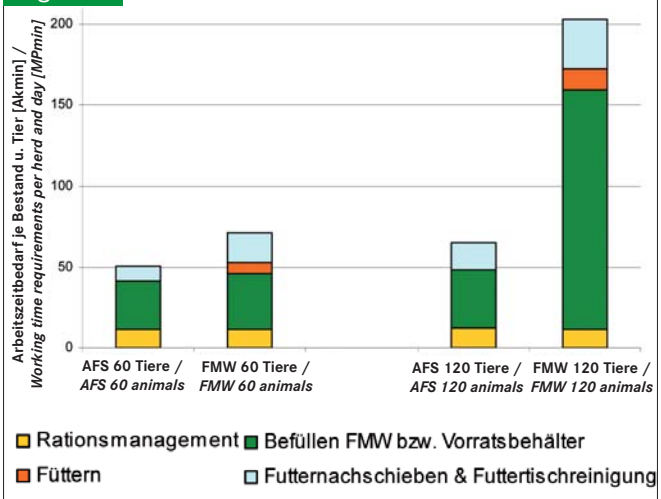
Reliability and functionality were rated good to very good by all respondents, handling predominantly good to very good. In some cases fault was found with excessively small displays on feed robots and with the long familiarisation phase. The farmers rated clear control computer layout as good to average. Following the requisite familiarisation period, the expectations of the feeding system were met on all the farms, especially with regard to reduced working time and flexibility. Many farm managers found that the animals suffered considerably less stress. Thanks to feed distribution several times a day they judged

that lower rank animals were able to ingest more and feed better, even with more than one animal per feeding place. Some farms with automatic milking systems found an increase in the number of milkings per day. The reason was assumed to be greater herd activity due to feeding several times a day.

Working time measurement results

Working time modelling showed that a farm with 60 animals and AFS had to spend 50.6 manpower minutes (MPmin)/day and a farm with 120 animals 65.2 MPmin/day. This includes the working time requirement for ration management, daily storage container filling and daily feed table cleaning. Feeding the same herd with a feeder-mixer wagon, including feed distribution and feed pushing three times, would require 71.3 MPmin/day for 60 animals and 202.8 MPmin/day for 120 animals. With a working time saving of 112.15 MPmin/day there are substantial differences in favour of AFS when filling dispensers and a feeder-mixer wagon for 120 animals. In addition, the time requirement for feed distribution does not apply at all to an AFS (**figure 2**).

Fig. 2



Comparison of the daily working-time requirement between automatic feeding systems and feeder-mixer-wagon

Discussion of results

AFS are relatively expensive and require a high initial investment (approx. € 80,000–170,000). The reason is that if at all possible they should be used for all feeding groups, including dry cows and young animals. The storage containers for the various feed components, particularly roughage, account for a substantial proportion of the investment cost, so the number of basic ration components used has a major effect on investment cost.

Working time measurement modelling showed a significantly lower time requirement for AFS than for a conventional feeder-mixer wagon. This supports corresponding statements by farmers in the survey conducted previously [2]. Bisaglia et al. (2008) arrived at a similar result in a simulated comparison of working times between AFS and feeder-mixer wagons [3]. Assuming a herd of 150 milking cows, the daily working time saving with AFS is 100 minutes.

Conclusions

By using an AFS it is possible to save time and achieve greater flexibility. A significant reduction in working time by comparison with a conventional feed-mixer wagon, however, can only be expected in the case of sizeable herds. It appears that not much time can be saved with herds numbering 60 animals, but flexibility for the farm manager becomes significantly greater. In view of the relatively high amount invested in an AFS, the profitability of such a system must be decided on a farm by farm basis. In principle an AFS can be a good opportunity for optimising working time and workload in dairy farming.

Literature

[1] Schick, M.: Dynamische Modellierung landwirtschaftlicher Arbeit unter besonderer Berücksichtigung der Arbeitsplanung. Habilitationsschrift. Universität Hohenheim, 2006

[2] Nydegger F. und A. Grothmann: Automatische Fütterungssysteme – Erhebung zum Stand der Technik. ART-Bericht 710, Forschungsanstalt Agroscope Reckenholz-Tänikon ART, Ettenhausen, 2009

[3] Bisaglia, C.; Pirlo, G. and Capelletti, M.: A simulated comparison between investment and labour requirements for a conventional mixer feeder wagon and an automated total mixed ration system. AgEng2008 – International Conference on Agricultural Engineering & Industry Exhibition, Hersonissos, Crete, 2008

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