

Experience with computer-controlled feeding techniques  
in dairy cattle management

Dr. H. Pirkelmann, Landtechnik Weihenstephan

The use of computers in dairy cattle management has so far been concentrated on the very important area of feeding, because the animal yield and thus the profitability of this farm activity can be directly influenced by safeguarding a nutrient supply designed to meet requirements. Although all dairy cattle rations are based on an adequate supply of high-quality basic feed, economic and nutrition physiology reasons dictate that the main emphasis is on the concentrate in feed distribution. Hence the development of computer-controlled feeding techniques was chiefly concerned with the concentrate supply. Meanwhile automatic "on demand" systems for loose housing have been introduced on a wide scale, whereas the likewise available automatic metering systems for the tying stall are used only occasionally.

To evaluate the computer-controlled feeding techniques, Landtechnik Weihenstephan conducted many investigations of individual farms and a survey of the use of automatic "on demand" systems in the Federal Republic of Germany. From the approximately 1000 systems in service at the end of 1980 about 355 usable survey results were obtained for evaluation.

The important criteria for evaluation of the "on demand" systems are eating behaviour, the accuracy of feed distribution, operational reliability, handling by the farmer and finally the effect on animal yield.

1. Animal behaviour and demand rate

The cows become accustomed to the "on demand" feeding within a few days, although 25 - 35 have to share an eating place in the feeding station. The eating cycle is affected by the feeding programs predetermined in the computer. Programs without fixed intervals (variable time program) with the possibility of continuous demand for food necessitate a substantially higher frequency of visits to the feeding stations than those with predetermined intervals (fixed time program) (Fig. 1). This affects the total movement activity in the herd and the quantity of feed consumed per visit, which is usually below 250 g in the first case and thus in an unfavourable range for volumetric metering devices and predominantly 500 - 1000 g in the second case. The nutrition physiology requirement of small consumption quantities distributed throughout the day is met by all programs.

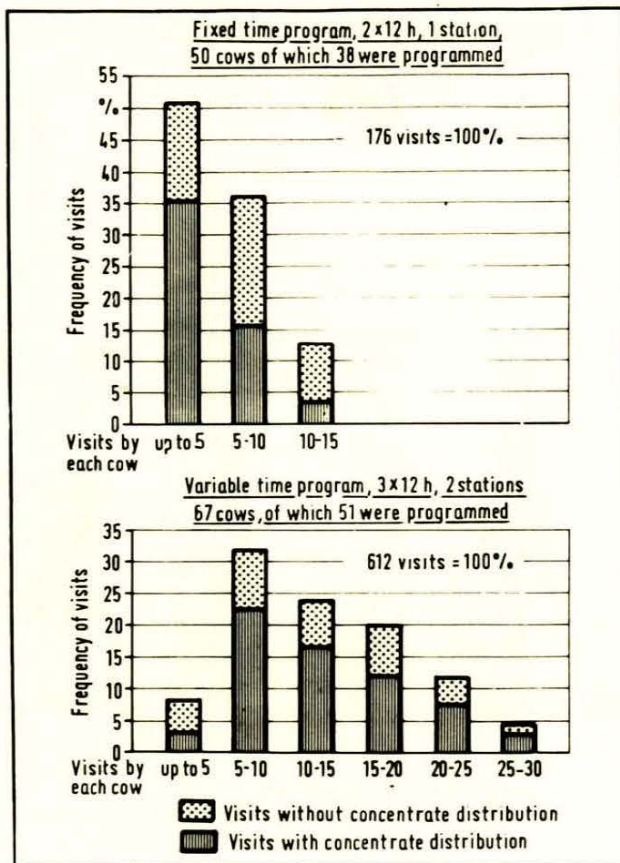


Fig. 1: Frequency of visits to automatic "on demand systems with different feeding programs

The cows adapt their eating behaviour very well to the feeding programs. On most farms the demand rate is better than 94 % (Fig. 2). In the case of the very good results over 97 % the variable time program with the possibility of transfer of residual quantities is better than the fixed time program. The mutual displacement of the cows from the feeding station occurs with both program variants. However, it has hardly any effect on the demand for food with the usual occupation density, because animals are rarely pushed out while eating. Unconsumed residual quantities are attributable mainly to leg injuries and other health troubles in addition to ranking, performance, occupation density, the location of the feeding station and the quality of the basic ration.

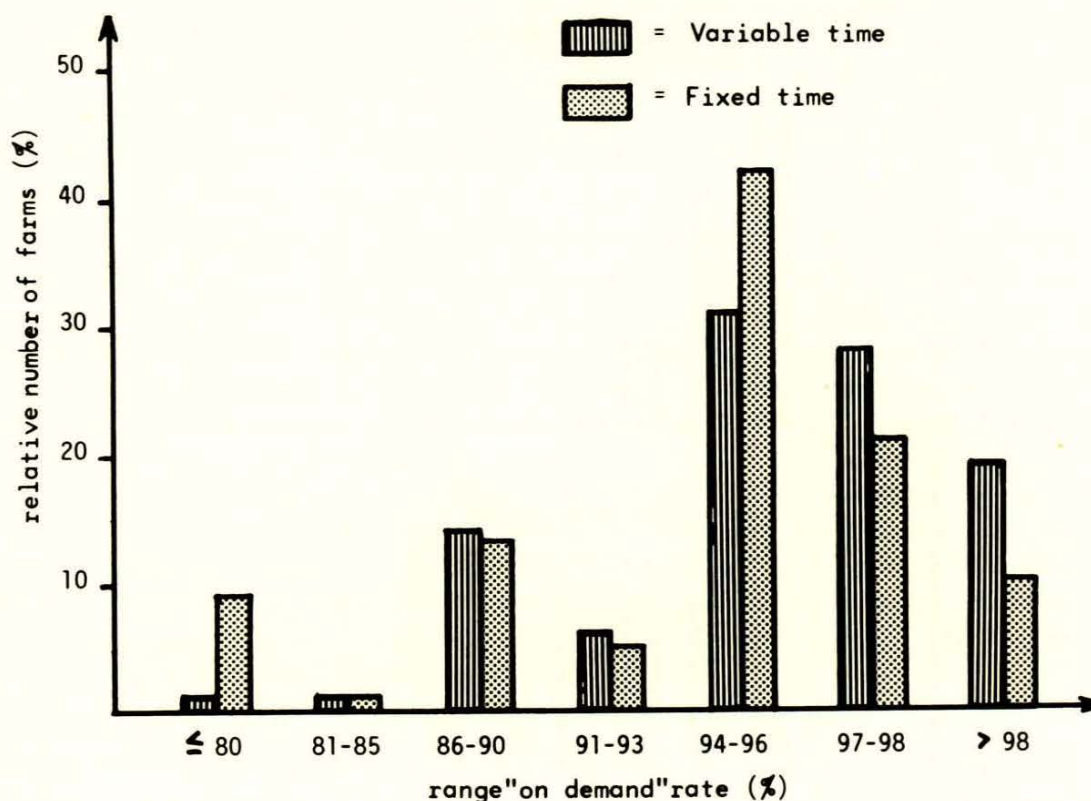


Fig. 2: Demand rates with variable and fixed time program

Quieter animal behaviour during milking is very often reported if the concentrate is no longer supplied in the milking parlour. However, about half the farmers stated that the animals are more reluctant to enter the milking parlour when the tempting feed is dispensed with.

## 2. Operational reliability

A distinction must be made between the mechanical and electronic components when evaluating the operational reliability (Fig. 3).

By far the most frequent causes of trouble were the strength of the collars and their locks. By contrast hardly any defects occurred in the signal transmitters (transponders) themselves. With regard to the electronic components about 30 % of the farms specified trouble with the computer. A similar high value was also specified for the concentrate dispensers. The other components operated satisfactorily. The operational reliability of the automatic "on demand" systems thus still leaves something to be desired. However, this applies both to the electronic and mechanical components.

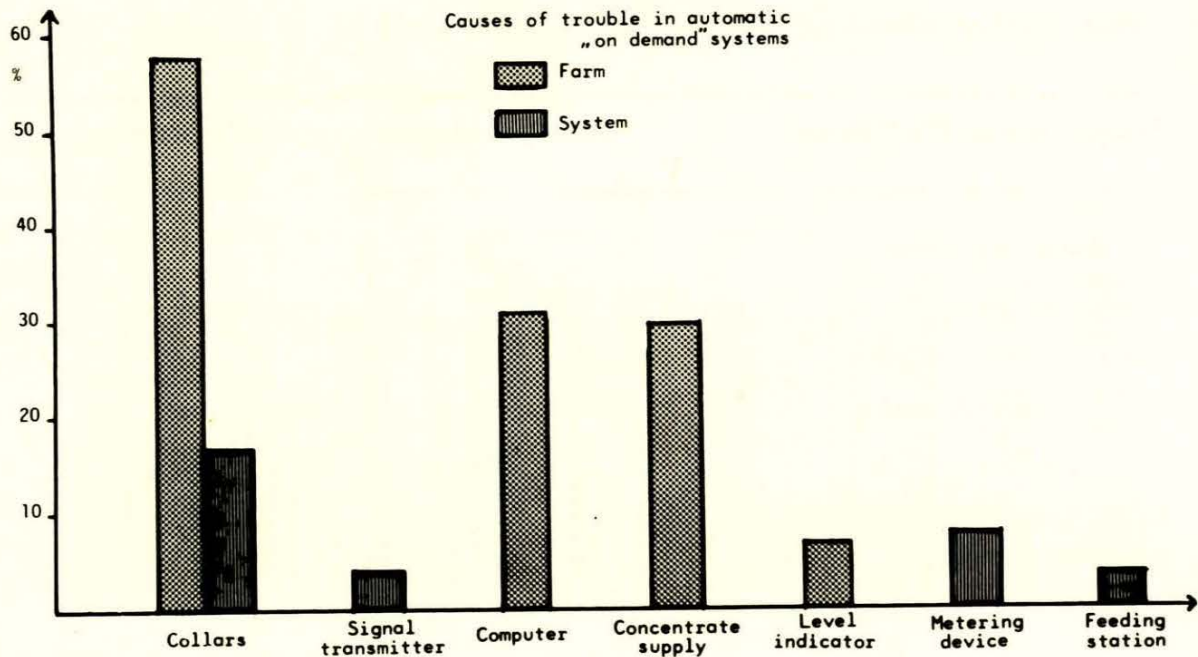


Fig. 3: Causes of trouble in automatic "on demand" systems

### 3. Handling by the farmer

Only suitable operation and maintenance by the farmer permits effective utilisation of the possibility of accurate adaption of the concentrate quantity to the animal yield in the "on demand" feeding system. This includes programming and checking of the consumption quantity on the computer, but also adjustment of the metering devices in the feeding stations.

In addition to the estimates of the nutrient supply from the basic ration only the results of the monthly official test weighings with their well-known sources of error are available to most farmers as a basis for predetermination of the concentrate quantities. For this reason the required concentrate quantities can be programmed only as accurately as the available data. Most farmers adjust the required quantities on the computer only every 4 weeks (Table 1). However, many users of automatic "on demand" systems attempt to utilise the opportunity of more accurate concentrate distribution through their own milk quantity calculations, particularly in the case of the fresh milking cows.

Table 1: Frequency of concentrate programming

Programming frequency	Fresh milking cow	Stale milking cow
3 times per week	48	0
Once per week	48	5
Once every 2 weeks	40	17
Once every 3 weeks	11	16
Once every 4 weeks	154	212
Less frequently than every 4 weeks	3	9

84 % of the farmers interviewed utilise the possibility of checking the consumption quantities at each milking time or at least once daily. By contrast the remaining 16 % usually check the residual quantities only once weekly or even less frequently and thus sacrifice an important advantage of this feeding system. An important measure for the accurate concentrate distribution is the discharge accuracy of the metering devices. Hence the volumetric metering devices used without exception require continuous monitoring and adaptation to the feed characteristics. Unfortunately this requirement is not met on many farms (Fig. 4). The deviations from the required values are sometimes very high. Wide variations also occur between different feeding stations in the same housing. Monitoring of discharge should be facilitated or weight metering adopted without fail in this case.

#### 4. Productivity

The total work involved in concentrate distribution in the loose housing is 1 - 1,5 man hours per animal per annum with the feeding techniques so far available in the milking parlour and is thus of minor importance. It can be reduced by the automatic "on demand" systems to 0,55 man hours per cow per annum. Programming accounts for about 17 %, checking for 56 % and monitoring of the feeding stations for 27 %. In this case the release from fixed working times should certainly be rated higher than the saving of working time with the required more frequent feeding.

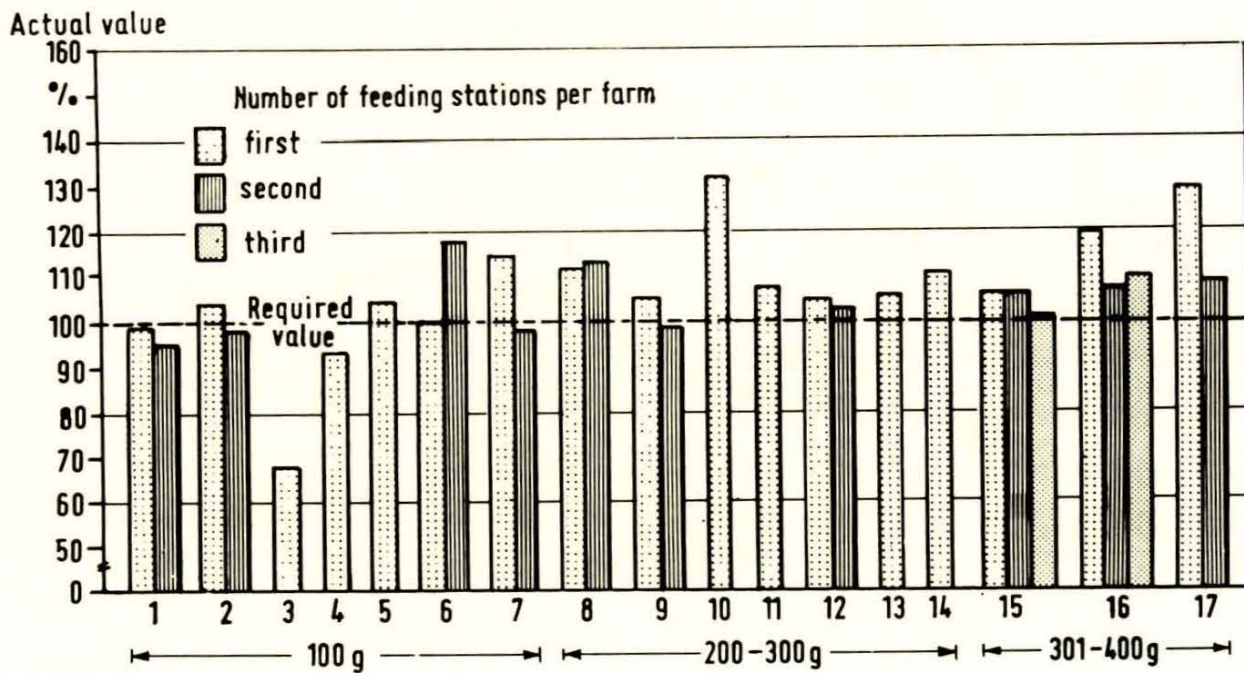


Fig. 4: Percentage deviations of the concentrate discharge quantities from the required

#### 5. Effects on the milk yield

In the final analysis the decisive criterion for evaluation of a feeding system is the effect on the animal yield. Widely varying experience has been acquired on the farms (Fig. 5). The differences in the milk yield in the year of investment in the automatic "on demand" systems vary in a wide positive and also negative range.

On average, however, there is a continuous increase in the milk yield, which was intensified by use of the automatic "on demand" systems. Even if a correction by the mean annual increase in the milk yield of 100 kg per cow is made, the automatic "on demand" systems produce an additional yield of about 100 kg. No effect on the fat content was ascertained, but the protein content increased by an average of 0,1 %. On most farms this increase in the milk yield can cover the annual costs of 60 - 100 DM with an investment of 300 - 500 DM/cow in "on demand" feeding.

As the increase in yield was greater on farms with a lower initial yield than on those with a high initial level, it can be assumed that the main effect is attributable less to the more frequent feeding than to the more accurate feed distribution.

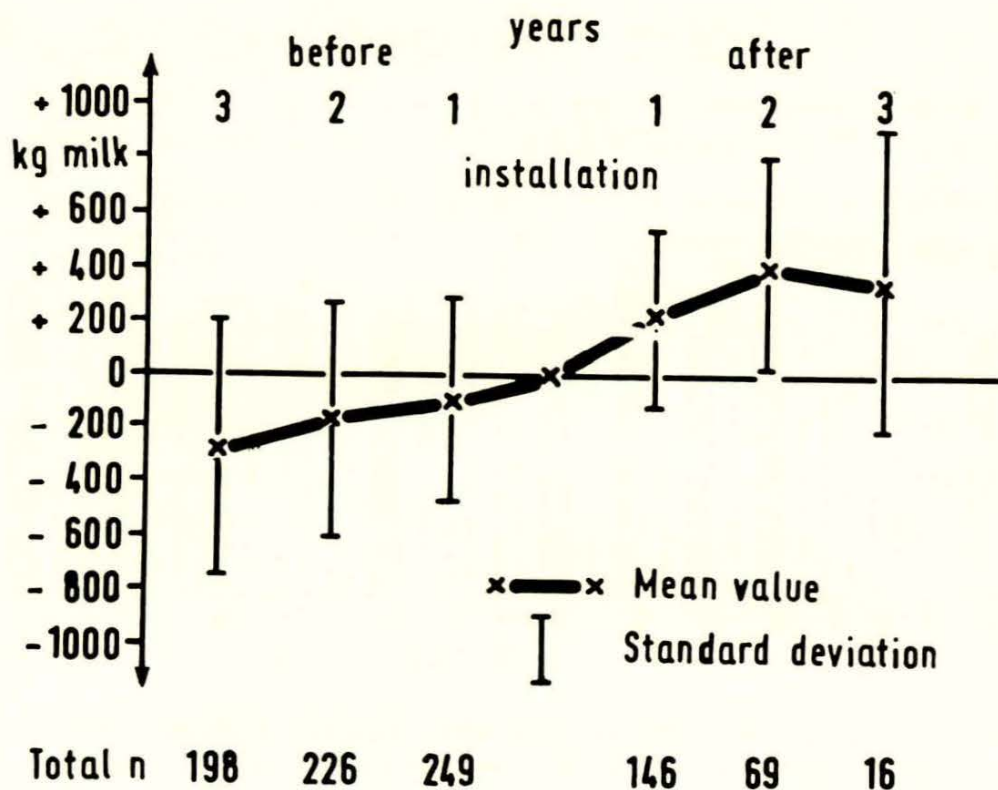


Fig. 5: Difference in milk yield before and after installation of the automatic "on demand" systems

At the same time the concentrate consumption also increased. The ratio of the concentrate used to the milk quantity produced remained approximately constant or deteriorated.

#### 6. Overall evaluation and further development

The automatic "on demand" systems are suitable for accurate distribution of the concentrate to dairy cows in conformity with the yield with a feeding frequency suitable from the nutrition physiology point of view without additional work. According to the animal behaviour "on demand" feeding is ensured when the feeding stations are properly installed and occupied. However, satisfactory operation and utilisation of all advantages of the system are not always achieved.

In a further extension stage the system should be supplemented by additional functions for automatic recording, storage and processing of the animal yield data and the production means used for a better basis for determination of the concentrate ration and well-founded evaluation of the productivity of the individual cows. The computer so far used only for feed distribution without full utilisation of its capacity would thus be upgraded to a multi-purpose instrument for control of milk production and use for financial checks on the farm.