MICROPROCESSOR BASED FARM MANAGEMENT SYSTEM FOR DAIRY FAMILY FARMS

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With the very intensive usage of automatic concentrate dispensers, problems have arisen with ration calculations based on milk yields. To overcome these problems, a multivariant estimation program was used with a microcomputer to predict the dry matter intake of individual cows. These data then were used to calculate the required concentrates for each cow. The program was used as part of a complete herd management system involving microprocessor-controlled concentrate dispensers, automatic milk yield measurement, and continuous automatic data transfer and data processing. Systems installed on practical farms have performed with very little loss of data and have shown that they offer possibilities for considerable savings in the use of concentrates and in labor requirements.

INTRODUCTION

In the Federal Republic of Germany, the average dairy herd size is about 15 cows. Only about 30% of the cows are kept on farms with more than 30 cows. On the larger farms, where opportunities exist to use greater automatation, the method of housing has changed from tied stables to loose housing systems. Two problems on these farms are high feed costs and high labor requirements. On most of the farms, the farmer and his wife provide all of the labor input. There is a very high workload, usually 65 hours per week and more. Analysis of production costs has shown that feed represents a major portion of the total costs, with concentrates representing nearly two-thirds of the feed cost. All possible efforts have to be made to reduce production costs through the improved use of cheaper and better farm-prepared feed and the installation of new techniques to reduce the work load.

REDUCING WORK LOAD BY AUTOMATING TASKS

Because of the high work loads, farmers in the Federal Republic of Germany have been willing to adopt new techniques very early. Concentrate dispensers especially were readily accepted by modern dairy farmers. Prior to the development of concentrate dispensers, there were problems with concentrate distribution in parlors because of high humidity. Furthermore, the accuracy of distributing concentrate by hand was unsatisfactory.

Presently, electronically controlled concentrate dispensers can be found in almost half of the loose housing barns. Normally, reprogramming of the dispensers takes place about every four weeks. Milk yield data and ration recommendations from Breeding Associations are the basis for calculation of the concentrate needed.

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More and more farmers are dissatisfied with this situation because adjusting concentrate volumes to a new milk yield takes a relatively long time. There are long periods of unnecessary over- and under-supply of concentrates. To correct the problems, efforts are being made to shorten the interval between milk yield detections, to install milk meters in parlors, and to take the collected data directly to a microcomputer for recalculation of concentrate rations and manual reprogramming of the concentrate dispensers. However, the real problem of unsatisfactory ration calculation is not being addressed by these actions.

IMPROVED RATION CALCULATION FOR DAIRY COWS

Presently, data on physiological and nutritional dependencies of the individual cow are unavailable at the time of ration formulation. Therefore, ration calculation for dairy cows is based on all animals within a herd having the same dry matter intake of roughage and silage.

Yet trials in animal nutrition have shown that the dry matter intake of each animal varies depending upon a number of factors related to the animal itself, the content of the feed, and the feeding technique (Fig. 1). Sastisfactory consideration has not been given to all these factors because it is too expensive to record them all on individual practical farms or because it takes too much manual time to do the ration calculations. To overcome these problems, we have tried to include the influences on dry matter intake in a computer program. Combined with estimated milk yields, the program is used to more exactly calculate the amount of concentrate needed and to program the microprocessor which controls the concentrate dispensers.

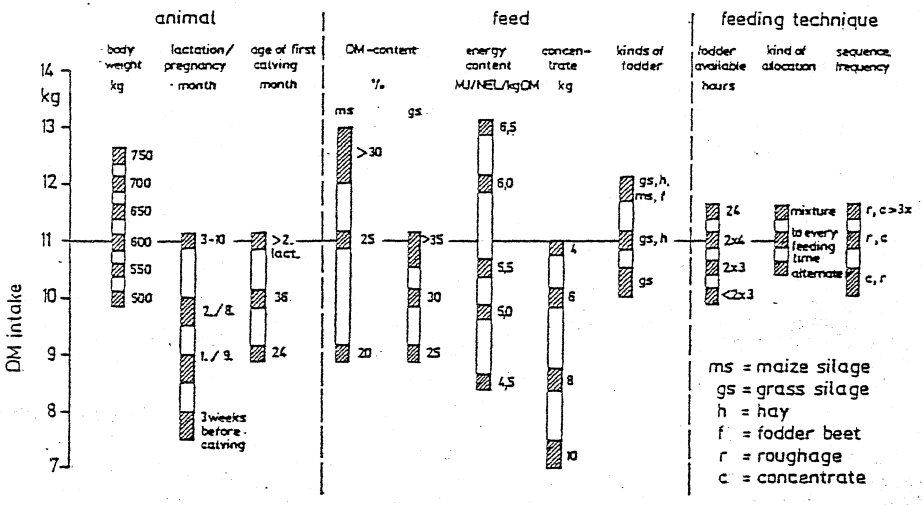

Fig. 1. Increasing and decreasing influence of dry matter intake of dairy cows (by Bohm, Jans, Kirchgessner and Rohr)

Results from a first trial with this method are shown in Fig. 2. These results show the possibility to save concentrate, on average about 1 kg/cow, without affecting the milk yield. These preliminary conclusions are rough and should be tested by further investigations in which the weight of the animals also is considered. Only after this more extensive testing can the saving of concentrate be assessed under real circumstances and under the same conditions.

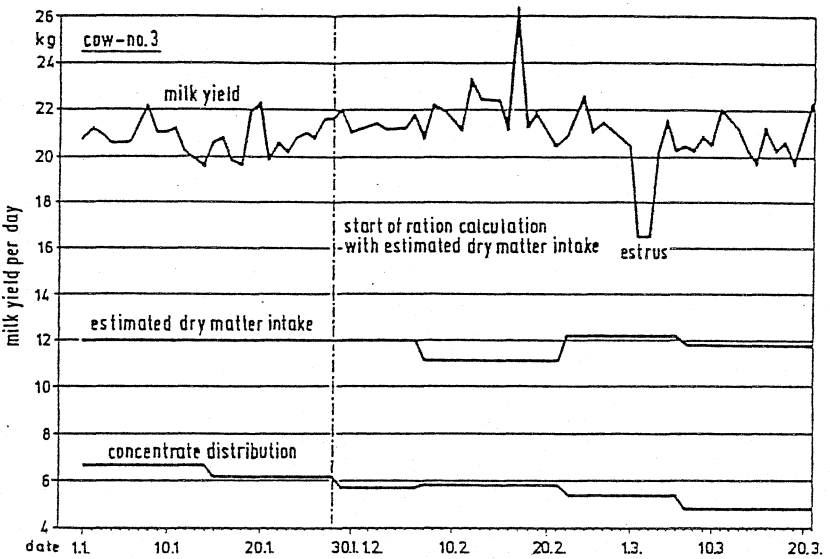

Fig. 2. Daily milk yield, estimated dry matter intake and concentrate consumption of a cow

MICROCOMPUTER-BASED HERD MANAGEMENT SYSTEM

A practical application of computerized ration formulation and concentrate feeding can only be reached if all related factors and techniques are brought together. Only then can we expect a reduction of work load and a highly automated production system.

To test such an automated system, the components shown in Fig. 3 were installed on three practical farms. The financial investment was shared by the equipment manufacturers, the farmers, and the Advisory Center. Support from the Institute has only been given during the time of installation and for the use of software from the Institute. All other work has been done exclusively by the farmer himself. After an experimental period of five years, the entire system will be owned by the farmer.

Every farm has 45 to 60 cows and has two concentrate dispensers, milk meters in the parlor, and an on-farm microcomputer (PC). The system is linked such that the PC can automatically, once each day, receive the measured milk yields and the amount of concentrate distributed per cow. Data receiving can be controlled by a time clock or by a multi-tasking operating system. The data are handled in an SQL-database.

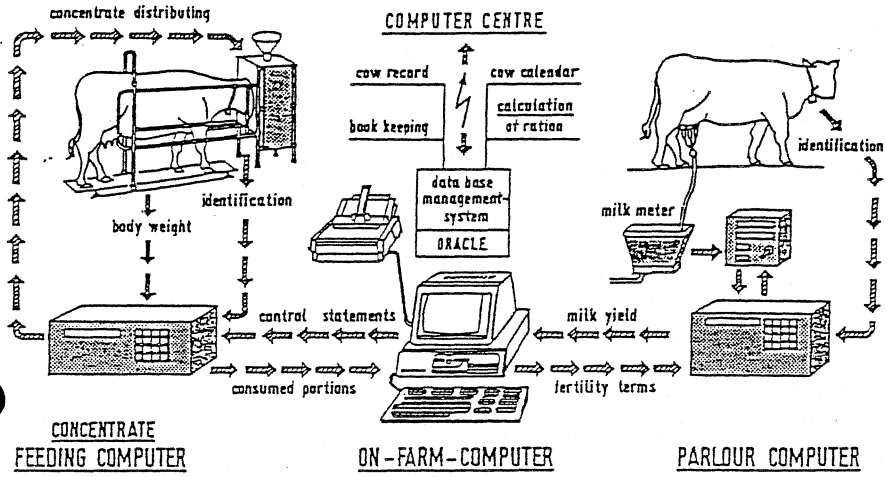

Fig. 3. Schematic of installed herd management systems

A special program monitors the daily milk yields and the concentrate consumptions. A very comprehensive print-out is produced for the farmer's files in which any special situations are noted. Cows for which milk yield deviates more than 20% from the previous day or for which concentrate consumption deviates by more than 10% are indentified and printed in an alarm list.

A cow calendar program is included as a central program in the PC. The output of this program is printed at the end of the daily alarm list and completes the monitoring function of the system.

The estimation of the dry matter intake of each cow is performed once each week by a computer program. The program is initiated manually by the farmer. The automatic transfer of the calculated concentrate rations from the PC to the microprocessor-based controller operating the concentrate dispensers is done after confirmation of the calculations by the farmer. The transfer of data can be for an individual cow or for the whole herd.

At present, an automatic data transfer of daily milk yields by video text to the Breeding Association is being tested. Following these tests, data on the analyzed milk contents should be brought back automatically by the same media to the farm for use in ration formulation.

Analysis of missing data (Fig. 4) for one farm with manual and time-clock controlled data transfer shows that the amount of missing data could be reduced enormously with a mechanically operated automatic data transfer system. The data also show that data losses increase during times of high work loads resulting from field work. Only a fully automated multi-tasking operating system can guarantee the highest data quality and the lowest work load for the farmer.

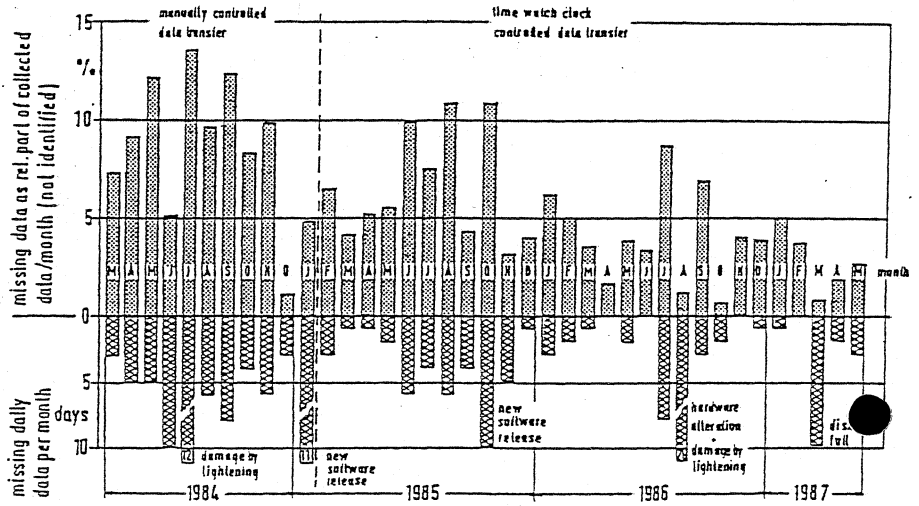

Fig. 4. Unidentified cows and losses during data transfer to the on-farm computer on a practical farm

CONCLUSIONS

The following conclusions can be drawn from the results of the installed herd management systems:

1. Automatic concentrate dispensing equipment will, in the future, be part of every milk-producing farm because it makes possible the reduction of work loads and the optimization of the ration dispensing for each cow.

2. The unsatisfactory system that presently exists for calculating the required concentrates can be replaced by an individual-cow multivariant estimation method which offers the opportunity to achieve better results with inexpensive software instead of very expensive and unreliable hardware measurement equipment.

3. Using the multivariant estimation method, analysis of the feed contents should be included in the near future. Fast methods for determination of feed contents could offer a solution for this problem.

4. Linking concentrate dispensers and milk meters into a complete herd management system requires an automated data acquisition and data processing technique.

5. Additional programs for monitoring of animal health and fertility are necessary, as are programs for monitoring the equipment itself.

6. The benefits of a complete herd management system cannot be quantified at the moment. Nevertheless, it can be seen that there are possibilities for saving concentrates and reducing work loads as well as further opportunities for improved farm management.

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