Jochen Baumeister and Bernd Lehmann, Osnabrück, Franz Freiberger, Grub, Jan Harms and Georg Wendl, Freising-Weihenstephan, as well as Klaudia Klindtworth and Wilfried Hartmann, Darmstadt

Dairy Cow Houses with Automatic Milking Systems

Results of the BMVEL-Model „Agricultural Construction" Project 2001/2003

The farms participating in the project were examined by scientific institutes for a period of three years, in order to determine how the new technology is proving itself under practical conditions, and which effects the entire system have on man and animal. Here the house climate, animal behaviour, milk quality, animal health and hygiene, consumption of supplies and operating inputs, as well as labour management and economic efficiency, were investigated.

In the context of the BMVEL model project „Agricultural Construction 2001/2003 dairy cow buildings with automatic milking systems" four farms with automatic milking systems (AMS) of different manufacturers were selected (see LANDTECHNIK 02/04, p. 119). In all enterprises the dairy cattle husbandry was the main business. The milking technology was installed in non-insulated stables, whereby similar structural solutions were attained. The results of the model project will be published by KTBL.

Stable climate

In the four examined non-insulated stables there were favourable conditions for the animals. The differences between outside and inside stable temperatures of up to 3 K promotes the thermal current within in the building and supports the air interchange. In the stables the mean temperature was in a range from -0.3 °C to 23.7 °C during the year and thus within the range of the thermal-neutral zone for dairy cows. Also the mean relative humidity in the stable, which is affected by the dampness of outside air, but also by evaporating of vapour by the animals, was with 60 % to 87 % in the range recommended for cattle (60 % to 80 %). Besides temperature and humidity the ammonia content of a stable air is a parameter for the air quality. Here the examinations showed that the stables had a good air quality, too, since the ammonia concentrations were definitely below the critical value of 20 ppm.

Animal behaviour

Operating an AMS requires a high acceptance by the cows of the milking area and the technology and hence a careful adaptation phase. This phase was relatively short on all farms with little additional assistance by the farmer (maximally 21 days). When training the cows different strategies were used. The farmers were assisted by the technical personnel of the manufacturing firms in different extent.

The recording of the behaviour showed that the activity of the cows is determined

Dipl.-Ing agr. Jochen Baumeister is employee and Professor Dr. agr. Bernd Lehmann is a professor at the faculty of agrarian sciences and landscape architecture of the Fachhochschule Osnabrück.
Dipl.-Ing. agr. Franz Freiberger is employee at the institute of animal husbandry and animal protection of the Bavarian national institute for agriculture in Grub.
Dipl.-Ing. agr. Jan Harms is scientific employee and Dr. Georg Wendl director of the institute for agricultural engineering, agricultural construction and environmental technology of the Bavarian institute for agriculture in Freising Weihenstephan.
Dipl.-Ing. agr. Klaudia Klindtworth is freelance, Dr. Wilfried Hartmann is scientific employee of the project area „husbandry and agricultural construction" of the KTBL, Bartningstr. 49, 64289 Darmstadt; e-mail: *w.hartmann@ktbl.de*

Keywords

Automatic milking, AMS, dairy farming, pilot projects, agricultural construction

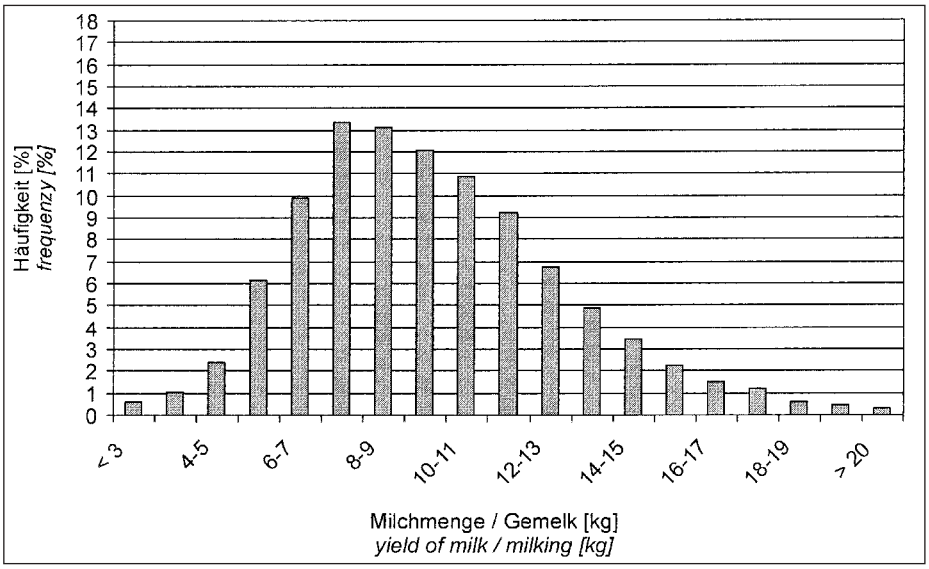


Fig. 1: Distribution of milk output per milking at farm Biechl (59 days, n = 6,851 milking)

mainly by the daily and night rhythm as well as by feeding, whereby tendentious two main dwell phases and two phases of high activity of eating were to be recognised. Most milking took place in the morning or in the early evening hours. The average milking frequency per cow and day was with 2.3 to 2.8 milkings. The distribution of the yields per milking showed that the predominant part of the single milkings was between 6 and 12 kg of milk. The portion of milkings with more than 14 kg of milk per milking (10 to 29 %) was caused generally by long intermediate milking intervals. This was the case when the cows visited the AMS irregularly or not on their own (*Fig. 1*).

Milk quality and hygiene

In milking, milk quality and a healthy udder stands in the centre. The number of microorganisms and the freezing point of the milk delivered reflect the hygiene and possibly existing foreign water in the tank milk. Both values were on a level that is achieved also with conventional milking technology. In individual cases excesses of the permissible limit value for the number of microorganisms were determined, which were caused by technical defects of the cleaning and cooling units. The freezing point of the milk was predominantly in the permissible range, with widely varying values. Meeting a low foreign water content masses still causes problems.

The cleanliness of the animals was valued after a fixed valuation code, which covered the areas udder, abdomen, haunch and foot. The cleanliness of the valued herds was on a high level. It showed that the areas haunch and foot were somewhat more dirty than udder and abdomen. Udder and abdomen showed middle degrees of uncleanliness from 2.1 to 3.4 % (*Fig. 2*).

Measure catalogue

In the model project special attention was put to the conversion of the measure catalogue for milk producers with AMS which was defined in 2001. The catalogue contains procedural instructions and planning criteria for observance of the milk directive. The results show that the strict standard values for the cell number could not always be met. This situation occurred especially then in the observed period, when there were temporarily suboptimal conditions in farm and herd management (e.g. silage quality). At no farm there was an indication that the causes for increased cell numbers could be seen in the management of the AMS or in insufficient observation and checking of the cows. They were rather - according to the statements of the farm managers - in the compositions of the feed rations, in single feed components with insufficient quality, in uncertainty of treatment of cows and last and even seldom in defect technology. Therefore the measures to be taken must go beyond the ascertaining the health status and recommendations for the treatment. Especially the basic causes for sanitation-requiring health status of the herd before and after sanitation measures must be found and repaired.

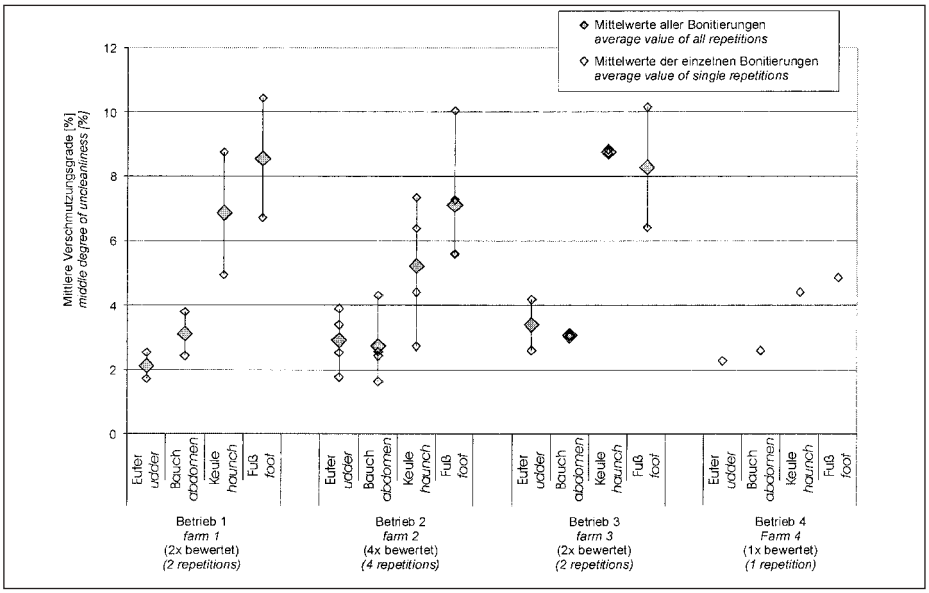


Fig. 2: Mean degrees of uncleanliness of the herd in the rated areas udder, abdomen, haunch and foot for various repetitions

The limit values in the measure catalogue proved to be meaningful for the introduction of the measures. Farms, in which the limit values were exceeded, had already problems with the health of individual animals at this time. Since exceeding the limit values for farms with AMS is not explicitly mentioned in the reports of the national recording federations (LKV) or of the dairies, this cannot be detected fast by the farmer. The farmer has the option to find out himself from the values of several messages whether a limit value was exceeded. The farms were usually aware also - without the exceeding the limit values - of existing problems. However it was also indicated that it would be helpful to get information about exceeding these limit values, especially with extreme worsened values.

All farms documented accomplished measures. The documentation took place however to very different extent. In particular walking in the stable and checking the automatically recorded data and warning lists demanded in the measure catalogue were conscientiously accomplished by all farms involved, noted however by no farm, how this measures could be documented with reasonable effort.

From the experiences of the farmers and the test results the following recommendations for the application of the measure catalogue can be derived:

The investigation twice of the total stock before start-up of the automatic milking system should be used for the reorganisation of the herd, since a reorganisation during operation of an automatic milking system is much more work intensive and causes more costly. When exceeding the limit values of the measure catalogue it is meaningful to prove this explicitly in the reports by the LKV and as also if possible in the reports by the dairies.

With the exceeding of the limit values a comprehensive analysis of causes is necessary. Besides investigating the health status of the herd and also the technology and feeding should be analysed, which are a cause or trips of the multiple factor illness mastitis. Moreover outside support measures for the management are meaningful by software solutions and by procedural instructions.

Supplies and operating inputs

The recorded current consumption by the consumers AMS, compressor and milk cooling units varied within a range from 15.800 to 65,000 kWh per year. The milking box or boxes had a share between 53% to 62% of annual consumption. Converted to the milk produced in the period investigated, the average use of electricity was 0.038 to 0.090 kWh per kg of milk, for the consumers specified above. The water consumption for the AMS including cleaning was in a range between 0.7 to 1.3 l water per kg milk. These values could substantially be reduced by opti-

mised features and advancements of the hardware during the examination (*Fig. 3*). Considering the existing servicing contracts and warranty by the manufacturers costs of about 2,300 to 3,300 €/year for supplies goods and wear components arose. The values consumed refer to the technical conditions of 2001. In the meantime the manufacturers accomplished technical improvements, which would result in other values.

Labour management

The work time studies showed that for the recorded jobs (office work, work with AMS, stable work in the cubicle house, special work, feeding and supply of the calves) altogether 4 - 5 man min per cow and day were needed, whereby the recorded time for working with the AMS was in a range between 0.1 to 1.1 man-minutes per cow and day. The AMS was intensively attended in the morning and in the evening. The frequency and duration of the jobs over the routine of the day differed from farm to farm. Both well structured routines during the day and also somewhat more uneven routines during the day could be observed. Tendentious a well structured operational sequence led to a reduction of the work time. However, the possible flexibility in timing operations can be reduced thereby.

Economic efficiency

For the farms examined, the accounting of the „part farm“ „dairy cattle with heifer raising“ was accomplished for the financial year 2001/2002 as total cost accounting. Total costs were between 32,1 to 44.6 cent/kg of milk for the farms examined. In all farms the direct costs with on the average 40 % had the highest share of the total costs. The factor costs placed with approx. 19 % were the second largest cost block. The share of the costs for milking varied within a range between 10 to 16 %. The remaining cost block (work operational costs, building costs, costs of production quota, other costs and costs of the raising a heifer) was in all four farms below 10 %. An exception formed were the constructions costs of 14% on one farm due to the complete transfer of the farm stead.

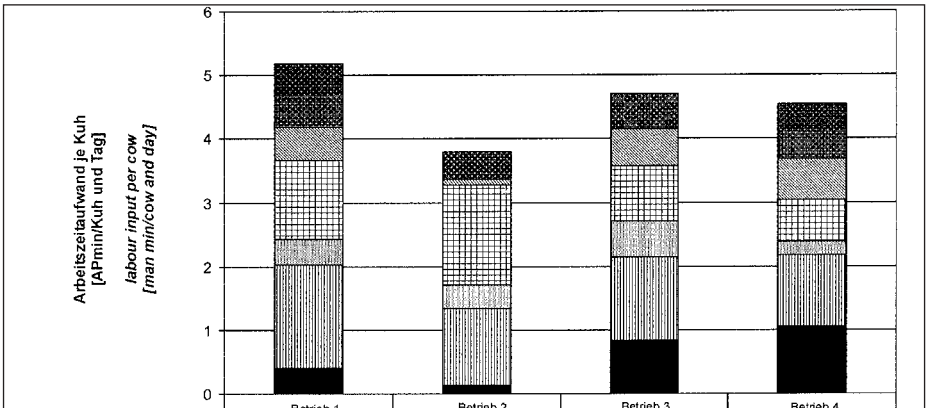
The computations indicate that with all farms the level of the direct costs depends mainly on the fodder costs and the direct costs for heifer raising. A detailed view of the milking costs shows depreciation costs of the AMS costs were between 2.4 to 4.2 Cent/kg milk. The variable costs of the AMS ranged 1.6 to 1.9 Cent/kg milk.

The model farms attained in the financial year 2001/2002 with the dairy cattle husbandry a total output 40.4 Cent/kg milk, ranging from 36,8 to 44.1 Cent/kg milk.

On the basis of the total output obtained, direct-cost margins were between 19.0 and 30.8 Cent/kg milk. The profit of the „part farm“ „dairy farm“ was between 1.8 and 14.1 Cent/kg milk. If the factor costs are deducted, then the „part farms“ obtained fictitious results with values from 7.8 to 6.7 Cent/kg milk. The profit per man-hour (profit divide by performed working hours in the milk production) is within a range from 5 to 29 €/man hour. The fictitious „part farm“ result was then between -23 to 17 €/man hour.

Result

The results of the model project show, how simple, freely ventilated non-insulated stables can be combined with most modern technology for the dairy-farming. This combination does not only meet the requirements of the animals, but contributes decisively to the flexibility of the work time organisation. The investigations show that automatic milking systems work satisfactorily in the practice farm, even if improvements are necessary in the detail, in order to reduce costs and improve economic efficiency. Regarding the milk quality and hygiene critical ranges are determined, which are based however rarely on problems with the milking technology. The measure catalogue provided in this connection is a meaningful assistance for the farms. It should be supplemented however with procedural instructions for farmers, LKV and dairies; a complete conversion is only possible with them. With declining prices for the technology it can be expected that the automation of milking will continue to gain significance also in the future and will hence contribute to the reduce of work loads (in particular with in middle farm sizes).



		Betrieb 1 *farm 1*	Betrieb 2 *farm 2*	Betrieb 3 *farm 3*	Betrieb 4 *farm 4*
Kälber	*calves*	0,99	0,42	0,56	0,87
Sonderarbeiten	*special work*	0,53	0,09	0,57	0,64
Fütterung	*feeding*	1,24	1,57	0,87	0,65
Büro	*office*	0,40	0,37	0,56	0,20
Stall	*stable*	1,62	1,21	1,31	1,12
AMS	*AMS*	0,40	0,13	0,84	1,06

Fig. 3: Labour input per cow and day for different work processes