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Working Time Requirements in Dairy Farming

For modern dairy farms, having accurate labour requirements for each individual work process is of the greatest importance, in order to exploit the available rationalisation potential and hence make the best use of the resource labour. Besides the process routines in milking and feeding, special and management activities become more important. The deliberate use of process-engineering and work organising tools makes it possible to reduce working-time requirements appreciably under otherwise identical conditions. In milk-production systems with herd sizes of between 40 and 1000 dairy cows, a total working-time requirement of between 90 and approx. 50 man hours per cow and year is to be expected.

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Literature

Literature references can be called up under LT 05415 via internet http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm.

Basic work-economics data for the work processes "milking", "feeding", "dung removal" and "special tasks" were recorded for dairy farming in 2004 and 2005 in the project "Validation and completion of working-time-requirement data in milk production" currently running within the framework of the KTBL Calculation Bases work programme. Data acquisition took place in Germany on dairy farms in Bavaria, Baden-Württemberg, Rhineland-Palatinate, North Rhine-Westphalia, Mecklenburg-Western Pomerania, Brandenburg, Saxony, Saxony-Anhalt and Thuringia. The size of herds studied varied between 18 and 2,400 dairy cows with annual milk yields of between 5,500 and 10,500 kg. Time measurements were also carried out in Switzerland in the Cantons of Aargau, Thurgau, Zürich, Baselland and Bern. Herd sizes here varied between 23 and 100 dairy cows, with milk yields between 5,400 and 10,000 kg.

For the studies, we had access to a total of 124 farms. Of these, 38 were chosen at random for the time measurements. On each of these farms, a detailed questionnaire was drawn up to cover the organisation of work (e.g. number of workers, state of labour force) and important influencing variables (e.g. number of dairy cows, milk yields, milking process). In this connection, an initial work observation was also carried out, in order to prepare the involved farm workers for the time measurements.

The time measurements were carried out with electronic time-recording systems (hand-held PC and integrated recording software) and were performed exclusively as direct work observation with individual time measurements on the element level. The essential influencing variables "Distances travelled", "Milk yields" and "Feed quantities" were specified during the time measurements and recorded electronically. All other influencing variables (e.g. milking-parlour width, milking-parlour length, cowshed length, feeding-table length) were recorded before and after the time measurements.

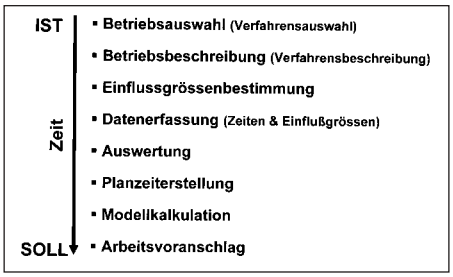

Fig. 1: Procedure for the acquisition, preparation and evaluation of key working time data [1]

With cyclical work-routine steps such as "premilking", "udder stimulation" and "milking-unit attachment", data quality was determined during the actual measurement via the Epsilon test. In this context, an Epsilon of < 10 % was judged to be good. Taking the determination of data quality as a starting point, it was also possible to determine the expected sample size n' after the recording of just a few measuring points. This made it possible to plan the time and effort for data recording [1, 2].

Repeated measurements were performed both for summer and winter situations, and for evening and morning milking.

The procedure for the measurements is presented in *Figure 1*.

For the milking processes, emphasis was placed on herringbone milking parlours (HMP), side-by-side milking parlours (SbS) and rotary milking parlours (ROT). In addition, tandem (TD) and auto-tandem milking parlours (ATD) as well as pipeline milking systems (PMS) were included in the studies. The smallest milking-parlour type examined had 3 milking units (MU); the largest milking plant operated with 60 MU.

With the feeding processes, the emphasis lay exclusively on feed mixers. Here, loading volumes of between 9 and 20 m^3 and self- and outside-filling arrangements were included in the work-economics studies.

For the dung-removal process, elevated cubicles and deep-bedded cubicles, as well as short-standing with open steel-grid-flooring extension and push-bar dung removal were included.

A total of 210 time studies were prepared during the course of the project; the essential cyclical work elements were recorded in several thousands of repetitions, to enable highly reliable statements to be made here (*Table 1*).

Evaluation, Element Database and Model Calculation System

For the further processing, the recorded data were first prepared in tabular form, then in-

Table 1: Overview of the number of measured key cyclical work elements using milking as an example (extract)

	Milking - routine work			
Work element	Premilking	Cleaning udder	Attaching MU	Dipping teats
No. of measurements [n]	3853	4193	4784	3566

vestigated with non-problem-oriented test processes (normal distribution, outlier, randomness). Where there was no normal distribution, a one-sided logarithmic transformation was carried out as a basis for the subsequent problem-oriented test processes and regression calculations. All tests were performed with Regressa 5.0 statistical software [3].

Next, the evaluated data were transferred in the form of planning-time data and functions to a planning-times database table, with each element being assigned a unique alphanumeric code, a name with beginning- and end points, and the appropriate statistical parameters, including contents description, author and creation date. [4].

The continuing calculation of working-time requirement values on the level of work processes was performed with the PROOF model calculation system [1]. This involves the logical linking of work elements with the quantitative and qualitative factors influencing them. All of the influencing factors are entered in the model calculation system as variables, and can be altered at any time within the upper and lower limits. For all work processes investigated in dairy farming, herd size has proven to be a significant influencing variable. In addition, the number of milking units used and the equipment of the milking parlour play a major role in milking. With the work process "feeding", by contrast, the number of components used as well as the process engineering of the feed-refilling are of crucial importance.

The model calculation system is of modular design, and in addition to the planning-times the database consists of the modules "list of influencing variables", "linkage area" and "output area". For each work process of interest, a separate extract from the planning-times database is created. This simultaneously defines a work-routine model. A list with influencing variables is then generated and logically linked with the routine model. Directly after the linking, the output area is created in the form of results tables and/or results graphics. In this connection, an information area with essential details on the current work process is simultaneously set up. All data are available for further processing in freely selectable formats.

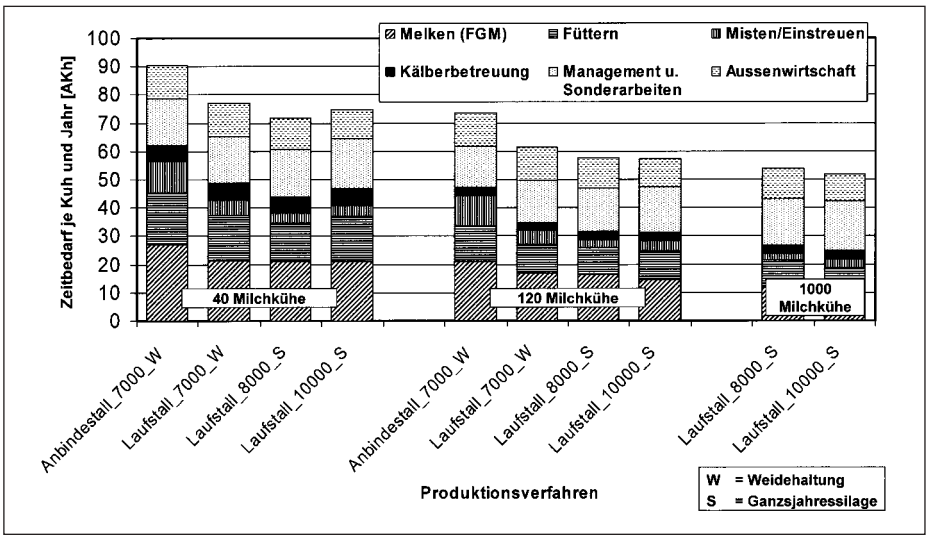

Fig. 2: Working time requirements of various dairy farming systems

Selected Results: Milking

The work routines for milking comprise preparation and cleaning times, routine times, and travel times, as well as any accruing waiting times. They differ according to husbandry- and milking process, but the single-farm work organisation as well as the mechanical and electronic work tools used must also be borne in mind. The routine times take up the biggest share of milking tasks, and differ noticeably between the individual milking processes (*Table 2*). Starting from this assumption, potential savings can be demonstrated. This can be illustrated in the comparison of a herringbone milking parlour with a rotary milking parlour: By automating the "letting in" and "letting out" work segments, nearly 25 % of the total routine time can be saved. For an assumed herd size of 400 dairy cows, this means a potential savings of 68 man minutes per milking process.

Table 2: Overview of routine times for various highly-automated milking processes (data in man-minutes / cow & milking process)

Melkverfahren / Anzahl ME	RMA 3 ME	TD 2 x 2	ATD 2 x 3	FGM 1 2 x 5	FGM 2 2 x 12	SbS 2 x 12	ROT 40 ME
Herdengrösse [Anzahl Kühe]	30	40	60	60	400	400	400
Kuh einlassen	0	0.26	0.03	0.21	0.10	0.11	0
Vormelken	0.14	0.12	0.12	0.11	0.11	0.10	0.10
Euter reinigen	0.40	0.22	0.28	0.23	0.12	0.09	0.13
ME ansetzen	0.28	0.20	0.23	0.21	0.17	0.23	0.16
Zitzendesinfektion	0.14	0.12	0.14	0.13	0.12	0.11	0.11
Kuh auslassen	0	0.22	0.04	0.18	0.05	0.05	0
Summe	**0.96**	**1.15**	**0.84**	**1.07**	**0.67**	**0.69**	**0.50**

Table 3: Description of the production systems investigated

Tied housing_7000_W	Tied-housing system with short standing, pipeline milking system, 7000 kg milk per annum, flat silo and round bales, distance to pasture 100 m
Loose housing_7000_W	Loose-housing system with deep-bedded cubicles, herringbone milking parlour, 7000 kg milk per annum, flat silo and round bales, distance to pasture 100 m
Loose housing_8000_S	Loose-housing system with elevated cubicles, herringbone milking parlour with service arm, 8000 kg milk / a, flat silo, year-round silage, miller-mixer
Loose housing_10000_S	Loose-housing system with elevated cubicles, herringbone milking parlour with service arm and automatic milking-unit attach ment, 10,000 kg milk /a, year-round silage, flat silo, miller-mixer

Working-time requirement: Production processes

Three herd sizes with 40, 120 and 1000 dairy cows, respectively, were selected for a comparison of the different production systems in work economics terms (*Fig. 2* and *Table 3*). Herds with 40 and 120 dairy cows are run as family operations without employees. Farms with 1000 dairy cows, on the other hand, have hired labour. It is clear to see that tied-housing systems always entail the highest working-time requirement, irrespective of the herd size. All loose-housing systems require less labour. Production processes with meadow grazing in the summer and preserved feed in the winter are more labour-intensive than those with year-round silage-feeding.

The savings effect in working time per cow and year for a change in herd size from 40 to 120 cows varies in these systems between 14 and 17 man hours or 19 to 20%. With a further increase to 1000 cows, the potential savings falls to 4 - 5 man hours per cow and year, or 7-10%. The potential savings can be ascribed primarily to the degree of rationalisation and improved manpower utilisation during milking tasks. However, this additional savings effect can only be achieved with an optimal arrangement of the cow houses, with short travelling distances for all those involved (milking staff, cows and cow-herders).