Development of an expert system for the determination of animal welfare in the specialised practice
"Cows and more" – what the cows tell us
Systematic classification, evaluation, advice

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Executive Summary

The aim of the project "Cows and more" was the development of an expert system with which it is possible, using animal and behavioural criteria, to discover weaknesses in husbandry and management in freestall dairy barns. The digital weakpoint analysis is based on a comparison of the individual farm with defined goals and comparison values of a specific data-pool. Moreover, scientific model calculations concerning animals, husbandry and management are used.
Through the digital collection of data with a touchpad, technical production advice in the dairy industry will be further optimised. Through the objective and systematic collection of criteria and indicators in relation to behaviour, disposition and metabolism of dairy cows, a standardised root-cause analysis will identify weaknesses. The software will allow the further development of important approaches to optimisation.
In the accompanying scientific work criteria and indicators were validated and the system reliability was checked. The assessment of 132 dairy farms with over 10,000 dairy cows resulted in the identification of a number of systematic differences.

Introduction

The economic environment in the dairy industry requires optimal production with healthy cows and stalls that meet the special needs of dairy cows. Important contributions to this have been made by appropriate management and through a corresponding technical husbandry environment. A key term often used in the last few years to describe part of the issue is "cow comfort" which is usually contrasted with construction and functional measures derived from animals. However, satisfactory results are not always achieved in this way. It appears, therefore, appropriate to capture more qualitative and quantitative parameters of animal behaviour and disposition and to derive from these through targeted observation and analysis vulnerabilities in husbandry and management.

So far snapshots of the situation in the barn have been subjectively recorded and used as a basis for advice. The technical background and the differing qualifications of specialist consultants may in addition lead to differing or even conflicting recommendations.

In cooperation with the Institut für Landtechnik of the Friedrich-Wilhelms University in Bonn and the Landwirtschaftlich-Gärtnerische Faculty of the Humboldt University in Berlin an expert system has been developed in order to determine valid animal husbandry and management related indicators and to objectively record these digitally in a matrix. The data will be transferred to a database after collection and will be available for use as reference values in the form of a datapool. The collected data from the Data-pool will be linked via a computer programme to reference values and compared with defined target values. From the identified deviations the production and management in the study enterprise may be evaluated and weaknesses analysed. With intelligent use of the programme, it will be possible to identify causes corresponding to weaknesses and in consultation with the farmer to develop possible solutions that may be directly incorporated into a protocol and action plan.

Method

In the recording software CowsAndMore, criteria and indicators will be used in order to objectively capture meaningful and valid behaviour, disposition and metabolic features of the cows in freestall barns. These criteria have high relevance in the assessment of husbandry and management. On the other hand the selected indicators are in practice simple and reliable to collect. The collection of data in the barn follows a sequence recommended by the programme that accounts for the timing of feeding. Some of the scores, such as the hygiene score for estimating the cleanliness of the cows were newly developed for this system. Other existing schemes corresponding to requirements have been adapted to the system, for example the DLG-scheme for classifying cow joints.

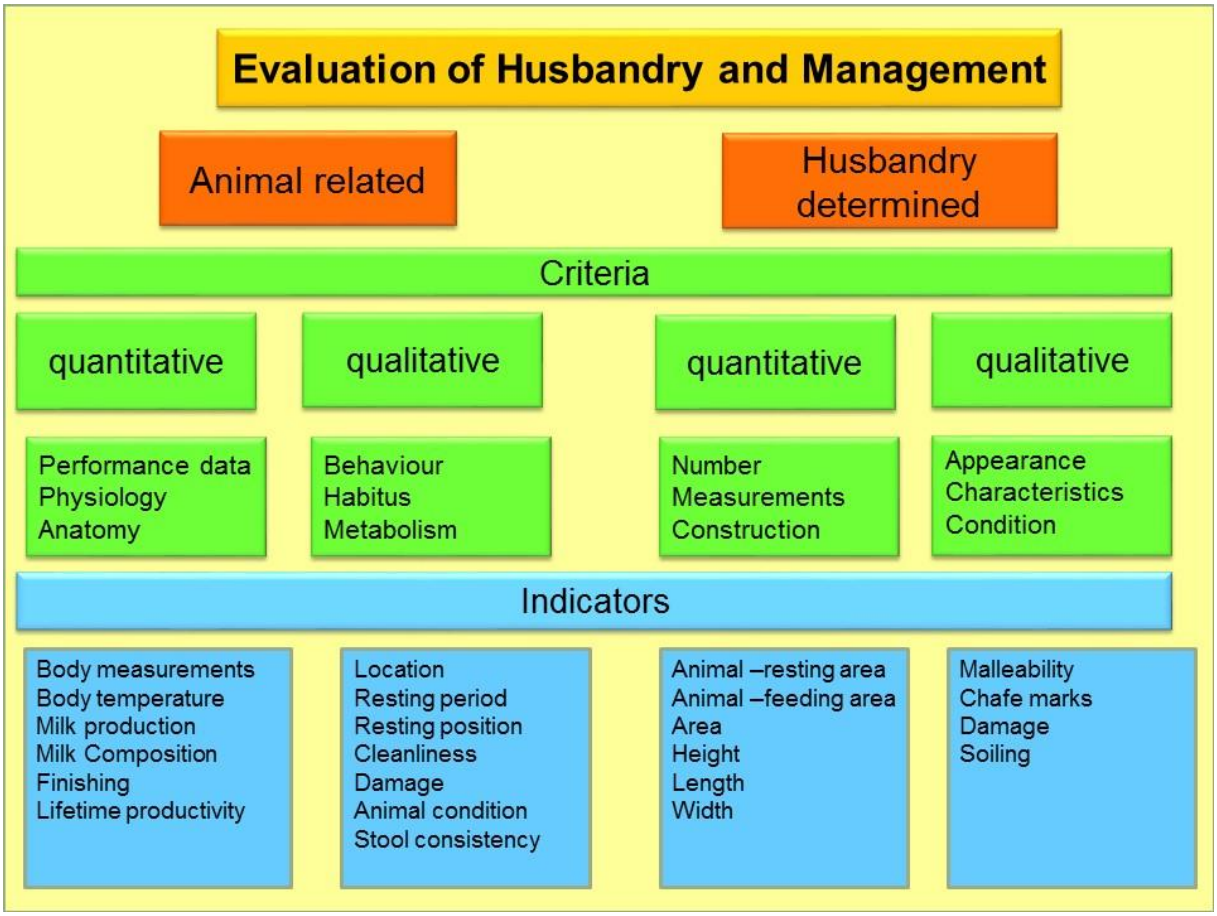

Figure 1: Criteria for the assessment of husbandry and management

Bodypart Classification

The developed hygiene score contains 7 body parts and 6 cleanliness levels. The goal is a cow that is totally clean, corresponding to a target value of 1 (clean). Significant soiling of certain parts of the body is usually a direct consequence of animal husbandry and management. For example, a very soiled tail-switch is primarily found with freestalls with high control rails and relative short resting areas. A strongly soiled rump indicates management influences such as a too little bedding in high and deep freestalls. Strongly soiled hooves indicate insufficiently clean alleys.

Figure 2: The hygiene score for digitally classifying the cleanliness of dairy cows using a touchpad (Example: K1 - K6 rump) (PELZER 2006) ((*1. Clean, 2. Lightly coloured, splashes, 3. Strong colouring, patches, 4. Stool hanging, 5. Beginning clodding, 6. Strong clodding))*

Damage to the integumentary system and husbandry induced disease and damage in the usual places are captured by the modified DLG-classification scoore. In 4 levels ranging from “clean” to “Joint disorder,” the state of the dewlap, carpus, withers, spinal column, tarsus, and the knee are classified for at least 20 cows or 20% of the herd.
In a second step the data contained in the database are assessed. To this end comparison values, benchmarks and target values will be taken from already available data from similar enterprises, appropriate literature and also partially from own studies and experience. Many of the values have been verified by accompanying studies.

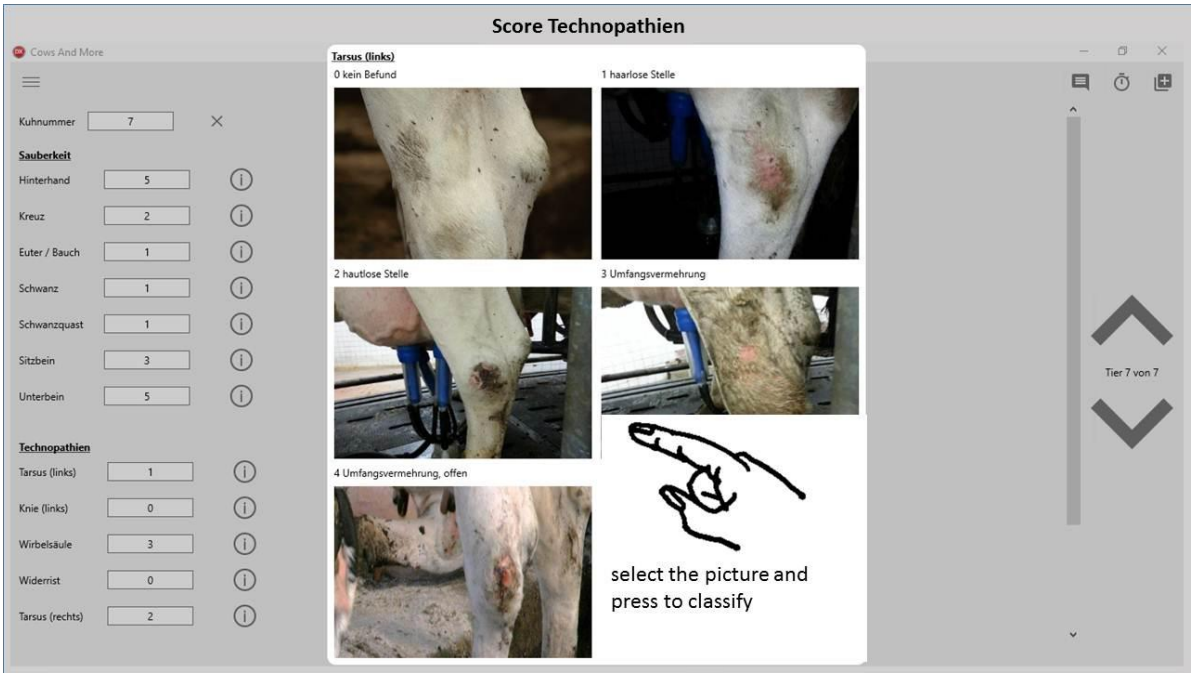

Figure 3: classification technopathien (example tarsus) (modified DLG-classification scoore)

On the one hand the normal values and range of collected data and also relationships between animal behaviour/disposition and the dimensions of the barn environment are to be determined scientifically via a statistical analysis.
Negative deviations from normal values (target comparison) indicate that there is a need for improvements in animal husbandry. Thus, in advising farm enterprises both good and less good characteristics of individual dairies should be indicated and reliable recommendations made. The collected data will be included in the database in order to enlarge the continuous data record.
As part of the evaluation, undesirable deviations identified by the user will be marked as weaknesses and included in the evaluation graph. The software displays the possible causes for the selected weakness.

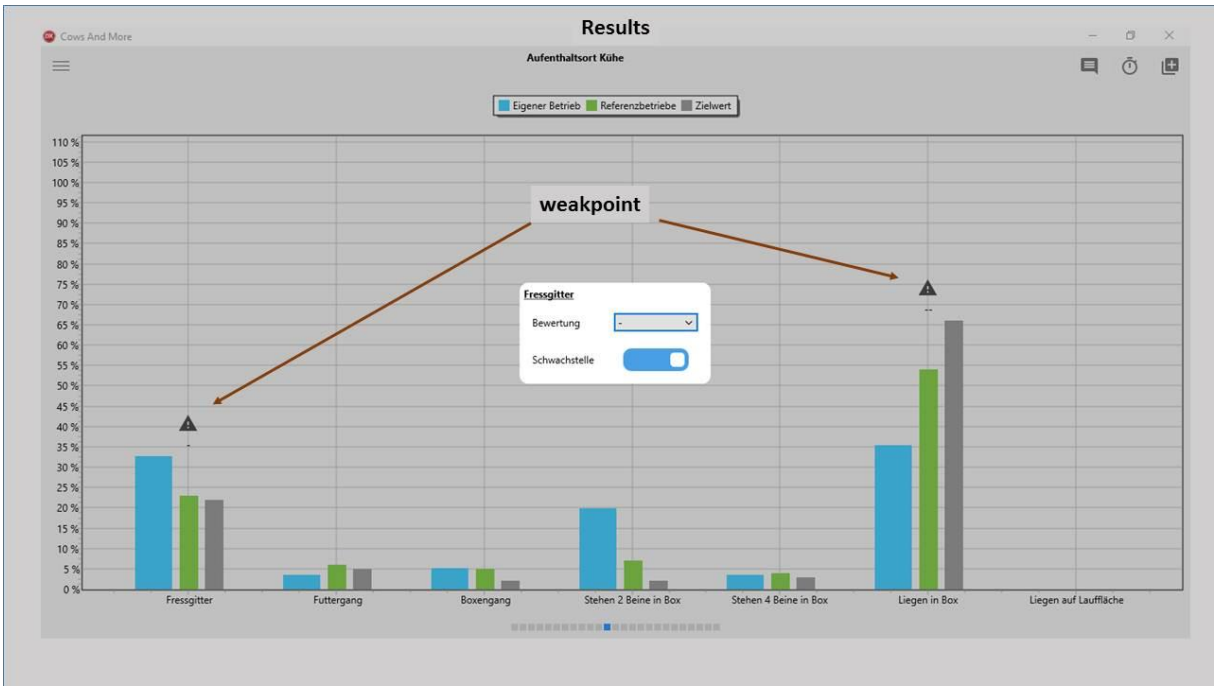

Figure 4: Behaviour in freestall
Feedfence, Feed alley, Freestall alley, Standing (2 legs in freestall), Standing (4 legs in freestall), Resting in freestall, Lying in alley
Blue: own farm, Green: reference farm, Grey: target value

The system
With “cows and more” a user-friendly IT supported and systematic root-cause analysis system is available for the dairy enterprise. By using Tablet PCs, you have the possibility to digitally record and classify behavioural characteristics such as animal cleanliness, damage and disease caused by husbandry, and damage to the integumentary system while in the barn. The system cows and more makes use of images to present in logical sequence different data entry forms for different classifications.

On the screen are shown corresponding classification areas and classification levels in understandable images. An evaluation may be conducted by choosing the corresponding image. Both the save procedure as well as the automated evaluation are carried out offline. The graphical presentation facilitates considerably a root-cause analysis. The programme recommends, based on the analysis, measures for improvement and documents the collected data, the evaluations and action plans in a protocol.

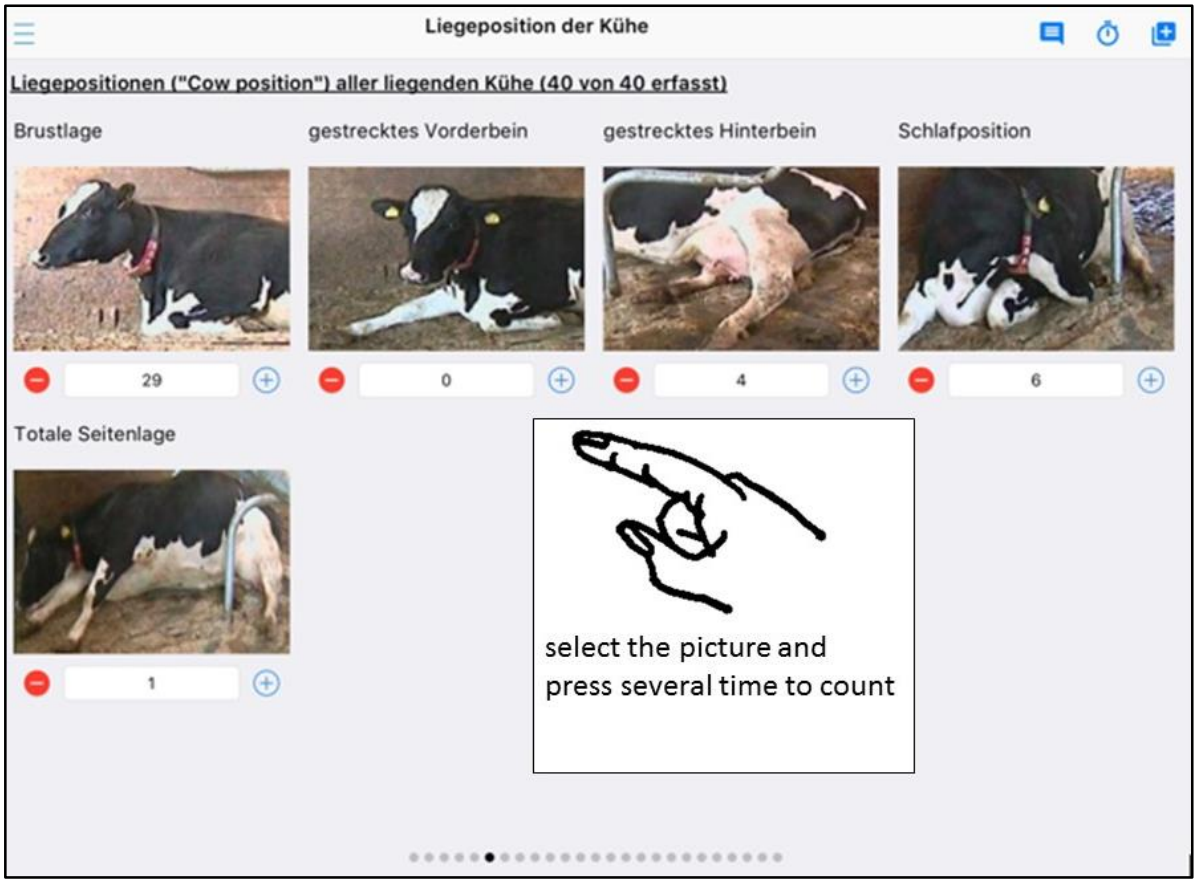

Figure 4:Iindicator lying position

Currently the tablet version of the system is available for iOS, Android and Windows. The first production version of the software is planned to go on sale in autumn 2016. It is planned, to extend the method for the systematic evaluation of milking and metabolism. The use of the system for evaluating a broad variety of farm animals such as horses and pigs is being considered.

The programme “CowsAndMore – what the cows tell us” was honoured with a gold medal in the software category by the German Agricultural Society (DLG) during EuroTier 2014, the world’s leading trade fair for animal production.

Dr. Katharina Dahlhoff received the Boehringer animal welfare award in the beef category in 2015 for her scientific involvement in the project.

Conclusion

The economic conditions in the dairy industry require optimised production in stall-systems with animal oriented management. With the software “cows and more – what the cows tell us” an expert system has been developed for tablet computers, with whose help animal and animal husbandry related criteria and indicators maybe objectively collected and analysed.
Through the digital support of the analysis process conclusions may be drawn about the quality of husbandry and management. In the context of the accompanying scientific analysis of this software links between animal behaviour and appearance and the cow barn environment and management can be shown. To further safeguard the relationships calculated from the data and in order to verify the targets, benchmarks and boundary values used in the root-cause analysis. Further studies into the project "cows and more" are to be conducted.

With this advisory instrument, all stakeholders are provided with an instrument for root-cause analysis with which qualitative and quantitative criteria of animal behaviour and disposition are able to be objectively and systematically collected and analysed. Using the results, uniform evidence-based recommendations for optimising animal welfare, barn environment and management can be made.

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