# Q Index: A nationwide welfare index based on DHI and cattle register data

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Q Check is an established animal welfare monitoring system in Germany, built on routinely recorded data from Dairy Herd Improvement (DHI) and the national system for animal identification and registration (HI-Tier). Covering around 85% of German dairy cows, DHI enables nationwide assessment and comparable analyses based on reliable on-farm data collection. In total 16 Q Check indicators combine complementary information from udder health, metabolic health as well as longevity and animal losses. Building on this framework, the Q Index project was initiated as a methodological extension to aggregate the indicators into three subindices (udder health; metabolic/digestive health; longevity/mortality) and one overall index. The aim was to develop a user-friendly system enabling transparent benchmarking and both horizontal and vertical analyses, with potential to support risk-based audit frequency control for quality assurance systems.

Nationwide DHI and cattle register data from 2021 to 2024 with quarterly resolution were available for index construction and application. Given that most indicators are percentages characterized by skewness, heterogeneous variances, and regional and structural confounding, a robust rank-based methodology was applied: All indicators were transformed into directed percentile ranks (0–100; higher = better). Subindices were calculated as the mean of ranked indicators within each group, and the overall Q Index as the mean of the three subindices. In the initial implementation, percentile thresholds were fixed based on the 2022 national monitoring dataset, ensuring vertical comparability over time.

The Q Index provides a standardized, nationwide animal welfare assessment based on routinely collected and reliable data from DHI. A rank-based approach reduces skewness and structural differences, resulting in stable, herd-size independent values. Interpretability is enhanced through its hierarchical design: the overall index provides a good overview, subindices reflect a summarized assessment within the indicator groups, and the underlying indicators enable targeted diagnostics. This rank-based construction enables intuitive visualization and simple between-farm and longitudinal analyses. By condensing multiple indicators into a structured and easily interpretable index system, farm-level evaluation is simplified and data-driven quality assurance strengthened.