Dairy herds continuously generate on-farm data that have a high potential for decision making support. However, variability among herds can be high and it can be, therefore, challenging for dairy producers and extension services to interpret farm records and identify best management practices. In this observational study, we used DHI data to identify the main factors explaining herd performance for 71 commercial Holstein herds in New Brunswick, Canada. A machine learning approach was used to generate high-level recommendations as well as detailed herd-specific recommendations. Enrolled farms were equipped with a parlour (n = 31), pipeline (24) or automatic (16) milking system. Herd performance records from September to December 2020 were assembled from a DHI database and included 71 indicators related to production, reproduction, health, and longevity. Herds were segmented based on their overall herd performance using hierarchical clustering based on principal components. The principal components were used primarily as pre-processing step to de-noise the data and to balance the influence of the similar DHI records. In-depth analysis of clusters was conducted using decision tree induction with the aim to generate an interpretable on-farm decision making tool. Three herd clusters were identified and consisted of low overall herd performance (Cluster 3; n = 17), a medium overall herd performance but high longevity (Cluster 1; n = 36), and high overall herd performance but with a concomitant low longevity (Cluster 2; n = 18). Decision tree induction further allowed to identify the most important DHI indicators explaining the adherence of a herd to one of the three clusters. This ultimately allowed to establish high-level recommendations and visualize which performance indicators a herd might want to focus on to improve overall herd performance. For instance, low performing herds were observed to be mainly driven by a low reproduction performance. In addition, single predictions of the decision tree algorithm were fitted with a local interpretable model. This latter approach allowed to add interpretability to the decision tree model and generate dynamic herd-specific recommendations for each farm. In conclusion, the results suggest that mining DHI data can give a valuable insight into best herd management practices and can be used to highlight opportunities for improvements.