Using dairy herd improvement data to monitor herd sustainability

D. Warner, J. Philion, R. Lacroix, D. E. Santschi and S. Adam

Lactanet, 555, boul. des Anciens-Combattants, Sainte-Anne-de-Bellevue, H9X 3R4, Québec, Canada
Corresponding Author: dsantschi@lactanet.ca

Abstract

Milk recording data have the potential to provide a dynamic picture of the overall herd status and management practices. We developed a dairy management tool to assess and monitor herd sustainability based on 10 routinely collected DHI indicators linked to key aspects of dairy management over the life span of a dairy cow. The indicators were selected by a committee of dairy industry experts and are related to longevity and culling (% cows in lactation ≥3; involuntary culling; cow mortality), feeding and production (% cows with milk urea nitrogen <5 or >18 mg/dL; Transition Cow Index; a management score index to evaluate how well the genetic potential of cows to produce milk is expressed), heifer management (calf mortality; age at first calving), and health (% cows with BHB >0.20 mM at first test; % cows with subclinical mastitis as SCC >200,000) at herd level (12-month rolling averages except for early lactation). Indicators were aggregated to a composite herd sustainability index (SI) and aimed to benchmark the overall herd sustainability of a herd relative to its peers and highlight specific areas with opportunities for improvements. The herd SI and benchmarks are computed three times per year and made available to dairy producers and advisor services via customized reports. Preliminary analyses were conducted with 2,608 dairy herds across Quebec and New Brunswick, Canada, to validate the herd SI with herd performance and profitability (12-month test date averages for 2020), and farm management practices collected through an online survey in 2020. Overall, with increasing herd SI, the herd performance improved for production (+8.9 kg/cow and day; top 10% versus bottom 10% herds for all reported results), herd longevity (−36% involuntary culling and −74% cow mortality), heifer management (−62% calf mortality), reproduction (−36 days open and −37 days for calving interval), for health parameters (−51% potential subclinical mastitis; −71% potential hyperketonemia), and herd profitability (+26% milk value and +$93,810 in operation margin). A descriptive study of association with farm management practices on 2,143 dairy farms highlighted some important aspects of calf, heifer, dry cow, and milking management. In particular, improving the stall surface and housing comfort, colostrum management, ventilation, and udder and hoof health were key aspects to improve the herd SI. In conclusion, milk recording data can be useful to assess and monitor herd sustainability and can help dairy producers adopt best management practices to improve the production performance and herd profitability.

Introduction

Sustainability is a global concept addressing the balance and long-term viability of a system. At the herd level, a sustainable herd would be a herd in an optimal balance between productivity, profitability, and longevity of the cows in the herd. This would therefore add-up to an overall performing herd with minimal incidence of disease and allowing for a good work-life balance of the producers. Using a similar approach by integrating different aspects of sustainability, Ryan *et al.* (2016) showed that the most profitable herds were also the ones performing best from an environmental sustainability perspective.

Due to the multidimensional nature of sustainability, a composite index for sustainability was created. A proof-of-concept with a comprehensive validation of the robustness of the composite index was published elsewhere (Warner *et al.*, 2020). The results showed that herds could be evaluated relative to their peers while maintaining the ability to intervene on specific areas with opportunities for improvement through the individual indicators.

Our objective was to evaluate the possibility to use routinely collected DHI information to calculate herd sustainability, and then compare this ranking to performance and profitability rankings.

Material and methods

To select the proper criteria to be included in the index, and with the objective of encouraging future adoption of the SI, we conducted a consultation with a committee of industry and research experts from various fields including nutrition and management, welfare, economics, milk recording. This committee had the precise mandate to come up with a list of routinely collected dairy herd improvement (DHI) variables that could be used to identify key parameters that contribute to overall herd sustainability. In addition, the committee had to ensure that these indicators would cover the full life cycle at the farm (birth to culling) without overlapping among chosen criteria.

Sustainability Indicators

A total of 10 indicators was chosen and grouped in four categories as detailed below.

Longevity and culling

1. *Cows in 3rd lactation and over (%):* percentage of cows in the herd that started at least a 3rd lactation in the last 12 months before the index is calculated.

2. *Involuntary Culling (%):* percentage of cows removed from the herd in the last 12 months for reasons classified as involuntary culling (reproduction, feet and legs, udder health, injury, …)

3. *Cow Mortality Rate (%):* percentage of cows removed from the herd for mortality during the last 12 months prior to the calculation of the index.

1. *Milk Urea Nitrogen (MUN) <5 or >18 mg N/dL (%):* average percentage of cows tested individually for MUN that had a result of less than 5 mg of nitrogen per dL OR more than 18 mg per dL in the last 12 months prior to the index calculation.

2. *Management Score for Milk (kg):* The general principle of the Management Score is to evaluate if the genetic potential of cows to produce milk in a herd is well expressed, isolating the "environment" portion of the popular "Phenotype = Genetics + Environment" equation.

3. *Transition Cow Index™:* Objective assessment of the success of the transition period at the herd level, based on Nordlund (2006).

Feeding and production

1. *Calf Mortality Rate (%):* Percentage of calves reported dead within the first 24 hours after birth over the last 12 months.

2. *Age at First Calving (months):* Average age at first calving of the animals that calved within the 12 months preceding the calculation of the SI.

Heifers

1. *Cows with BHB >0.20 mmol/ l milk (%):* percentage of cows with a result greater than 0.20 millimoles of Beta hydroxybutyrate (BHB) per liter of milk during the 12 months preceding the calculation of the SI.

2. *Cows >200,000 cells/ml (%):* percentage of cows that had a somatic cell count (SCC) greater than 200,000 in the 12 months prior to the calculation of the SI.

Health

A percentile rank (1-99) is assigned for each of the ten parameters for each herd and the ten percentile ranks are summed to establish an overall ranking of the herds. This overall ranking is then re-expressed as a percentile rank, which is the SI of the herd. Herds can therefore compare against peers for their overall SI, but also for each of the ten indicators separately to better identify and improve weaknesses.

In order to have a SI calculated, a single herd must have at least seven out of the ten indicators available at milk recording (some are optional). For any missing data, a percentile rank of 50 is assigned. The SI is calculated for all Canadian herds three times a year (April, August and December). Each reports presents actual results as well as historical performance of the herd over the last two years to monitor improvement.

Sustainability Index Calculations

A subset of 2,608 eastern Canadian herds were used to compare performance of top herds according to the SI versus the top herds in terms of performance (Table 1).

Overall, with increasing herd SI, the herd performance improved for production (+8.9 kg/cow and day; top 10% versus bottom 10% herds for all reported results), herd longevity (−36% involuntary culling and −74% cow mortality), heifer management (−62%

Results and discussion

calf mortality), reproduction (–36 days open and –37 days for calving interval), health parameters (–51% potential subclinical mastitis; –71% potential hyperketonemia).

Simulations were done using a fictional herd with a quota of 100 kg of butterfat/day (Canadian supply management system and milk prices), Overall herd profitability was increased (+26% milk value and +$93,810 in operation margin) for herds in the top 10% for SI.

A descriptive comparison was made to compare performance and demographics of the best herds for SI versus the best herds in terms of milk value (milk yield corrected for price of milk components; Top 10% for both groups; Table 2).

Top SI herds had slightly lower corrected milk (-2.9 kg/cow/d) but improved milk quality and higher longevity due mainly to reduced culling.

Finally, a descriptive study of association with farm management practices on 2,143 dairy farms collected via a questionnaire (Lactanet, 2021) revealed some important aspects of calf, heifer, dry cow, and milking management. In particular, improving the stall surface and housing comfort, colostrum management, ventilation, and udder and hoof health were key aspects to improve the herd SI.

Table 1. Comparison of demographics and performance of bottom, average and top herds for the sustainability Index (SI) based on 2,608 eastern Canadian herds.

	Bottom 10% SI	Average SI	Top 10% SI
Production			
Fat (%)	4.16	4.10	4.09
Protein (%)	3.22	3.18	3,18
SCC ('000 s.c./ml)	263	193	137
Milk (kg/year)	8,414	9,844	11,023
Corrected Milk (kg/day)	31.4	36	40.3
Demographics			
3rd lactation or + (%)	37	42	46
Culled Cows (%)	39	34	32
Involuntary Culling (%)	23	19	15
Age at First Calving (months)	27.1	25.2	23.9
Reproduction			
Calving Interval (days)	432	409	395
Days Open	152	129	116

Table 2. Comparison of demographics and performance of the best 10% herds for sustainability index and milk value (CAN$/cow and day).

	Sustainability index	Milk value
Production		
Fat (%)	4.09	4.03
Protein (%)	3.18	3.15
SCC ('000 s.c./ml)	137	170
Milk (kg/year)	11023	11990
Corrected Milk (kg/day)	40.3	43.2
Demographics		
3rd lactation or + (%)	46	41
Culled Cows (%)	32	38
Involuntary Culling (%)	15	21
Age at First Calving (months)	23.9	24.2
Reproduction		
Calving Interval (days)	395	401
Days Open	116	121

Customized reports are published three times per year and made available to dairy producers and advisor services, including historical records to monitor changes over the last two years (an example as well as additional information on the SI can be found on online: https://lactanet.ca/en/thematique/farm-sustainability/).

Conclusion

In conclusion, milk recording data routinely collected and available in DHI databases was used to develop a herd sustainability index and compare herds across Canada. The SI can be useful to assess and monitor herd sustainability and can help dairy producers adopt best management practices to improve overall production performance and herd profitability.

Acknowledgement

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