A holistic approach for monitoring the environmental sustainability of the Italian Holstein cattle population

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Abstract

This work aims to describe the holistic approach for monitoring the environmental sustainability that the Italian Holstein, Brown, and Jersey Breeders Association (ANAFIBJ) is implementing. Since 2015, ANAFIBJ has been setting up a wide range of environmental strategies to record data and to develop tools that meet community and farmer needs on mitigation climate change. In 2018, ANAFIBJ started collecting innovative data for each young calf housed at the experimental farm of ANAFIBJ. Several phenotypes, for over 200 young bulls, were recorded using advanced technologies, including the GreenFeed system (C-Lock Inc., Rapid City, SD, USA) and the Roughage Intake Control system (Hokofarm Group, Marknesse, The Netherlands). A new pipeline was developed to incorporate these new traits into the routine database maintained by ANAFIBJ, which is updated daily. At the population level, the Association formed a Consortium with various stakeholders, including University Experimental Farms, Commercial Farms, Universities, and Private Companies for recording routine environmental traits recorded on the Holstein female population. Methane emission records, from the GreenFeed system and the Sniffer type systems, milk-spectral records, from mid-infrared spectroscopy of milk labs, ruminal content, and microbiota composition, collected from key individuals on the population, will feed into the central ANAFIBJ data flow system. This will allow in the near future to set-up a genetic evaluation for these innovative traits and build up stronger cooperation at the international level. The Life Cycle Assessment (LCA) has been applied to several dairy herds enrolled in the national herd book. Now, LCA predictions can be made for all national dairy herds using the routinely recorded data in the ANAFIBJ national database. More herds are expected to have LCA recorded scores in the future. Further, an innovative report, named the "green passport", was generated to summarize the methane emissions and feed and water intake records of each bull housed in the experimental farm managed by ANAFIBJ. Each tool plays a pivotal role in allowing farmers across the country to assess the environmental impact of their herd and inform decisions regarding herd management.

Keywords: greenhouse gas emissions, data-collection, GreenFeed, sniffer.
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Introduction

Enteric methane emissions from ruminants are a major contributor to atmospheric greenhouse gas accumulation. Accurate measurement of methane production in ruminants is crucial to not only develop reliable national greenhouse gas emission inventories, but also evaluate mitigation strategies for methane emissions. Measuring actual enteric emissions in livestock is complex, expensive and time consuming. Many different research and industry bodies globally are investigating the feasibility and accuracy of a range of different techniques for recording enteric methane emissions and to create an automatic data streamline to storage data.

Material and methods

Available on market there are two different ways to perform an environmental sustainability evaluation: direct methods and indirect one. In the first category there are many different instruments as respiration chamber, portable accumulation chamber, SF6, breath sampling during milking and feeding, Greenfeed® and laser systems. Indirect methods or proxies are predicted indexes, milk spectra records (MIR), ruminal microbiome data and LCA. Generally, these two methods are considered separated. In the Italian holistic approach these two methods need to be integrated because direct data are crucial to validate proxies, while proxies are necessary to extend an environmental sustainability evaluation on large scale.

- Objective of this project areCollect GHG emissions data using different methods:
    - Greenfeed®
    - Moologger®
- Collect innovative traits data:
    - Milk Spectra Records (MIR)
    - Ruminal Microbiome data
- Validate proxies;
- Developtools, certifications and services that meet community and farmers need of mitigation climate change;
- Set-up a genetic evaluation also including innovative traits.

The first step was in 2019 with the collection of methane, carbon dioxide emissions, feed intake and water intake data into ANAFIBJ Genetic Center on Italian Holstein young bulls candidates to Artificial Insemination in Italy.

Two years later, in 2021, a daily automatic data pipeline was created to incorporate new traits into the routine database maintained by ANAFIBJ.

In 2023 the Italian Sustainability Consortium (ISC) was founded including University, Experimental Farms, Research Centers and Private Companies. To be part of the project, key farms must have some features: they have already been equipped with an Automatic Milking System (AMS) or an Automatic Feeding System (AFS) and must be registered. ANAFIBJ into these key farms will install some additional equipments,as Greenfeed® or Moologger. This structure and organization allow to collect a large

variety of data: CH_4 emissions from GreenFeed or Moologger, type traits, milk spectra records, ruminal microbiome data and weight.

In 2024 an automatic data streamline has been created to incorporate Consortium traits into the routine database maintained by ANAFIBJ.

Results

Up today, ANAFIBJ database in composed of the following data collected on 272 Italian Holstein young bulls:

- 36,653 CH_4 records from Greenfeed®.
- 559,800 feed intake records.
- 6,491 water intake records.
- 2,181 BCS records.
- 6,543 biometric measures records.
- 2,315 weight records.

In addition, some data are available also for Italian Holstein cows:

- 25,400 CH_4 records from Moologger®.
- 66,864 CH_4 records from Greenfeed®.
- 108,624 feed intake records.
- 2,997 weight records.
- 2,853 rumination records.

For each animal, male and female, as Italian Holstein Green Passport is produced. This passport can be considered as a animal functionality and environmental impact report. At the moment in the report are reported only phenotypic data. Phenotypic data are compared to average phenotypic data of the population. In the near future indexes will be includes.

For each farm enrolled in the project an environmental sustainability evaluation using LCA approach is performed. At the moment in the LCA evaluation, average predicted methane emission index is used, but in the near future it will be replaced by direct data.

Conclusion

Data collection on key-farms is crucial to create a national inventory about sustainability traits (direct and proxies) and to set up a genetic evaluation. Of course, data collection in commercial farms is going to be enhanced. LCA in a key-tool to perform high-quality technical assistance using an holistic approach.