Building a Global Integrated Methane Data Ecosystem: Harmonizing Measurement, MIR, and Genomic Data to Accelerate Livestock Methane Mitigation

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Enteric methane mitigation in dairy and beef systems requires accurate measurement, scalable prediction tools, and coordinated global collaboration. However, current research efforts remain fragmented across measurement technologies, biological layers, and institutions, leading to duplication of work and inefficient use of resources. Our ongoing initiative builds on the foundation of the GEMS project (Accurate Gas Emissions Measures from Cattle with the GreenFeed System) by creating an integrated, international data consortium that harmonizes methane phenotypes with complementary biological and management datasets. The core objective is to (1) harmonize international methane measurement datasets to improve methodological standards and data comparability; (2) integrate mid-infrared (MIR) milk spectra and genomic data alongside methane phenotypes; and (3) develop standardized analytical pipelines that enhance predictive modeling and support genetic and nutritional mitigation strategies.

We are building a centralized, FAIR-compliant data infrastructure that aggregates high-resolution methane data measured using GreenFeed, respiration chambers, and SF6, together with animal performance, diet, MIR spectra, and genotypes. Standardized Data Usage Agreements (DUA), harmonized metadata templates, automated validation pipelines, and shared governance structures ensure secure and interoperable data exchange. About 50 organizations worldwide have expressed interest in contributing data. Within the first month of formal data collection, 10 organizations have signed the DUA, and around 50 studies are actively flowing into the data pipeline. Preliminary results demonstrate the feasibility of coordinated global data integration and reveal heterogeneity in measurement protocols, reinforcing the need for standardized processing guidelines. Early harmonization efforts have improved cross-study comparability and enabled expansion toward scalable methane prediction using MIR and genomic information.

Together, a unified global methane data ecosystem strengthens statistical power, reduces redundant research, and accelerates the development of dependable monitoring, prediction, and mitigation tools. This provides a scalable pathway to support evidence-based methane reduction strategies and long-term genetic improvement in livestock systems.