New Insights on Data Integration and Artificial Intelligence to Predict Primiparous Lactation Curves Capturing Genotype-by-Environment Interactions.
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Abstract: We are developing a Dairy Brain by applying precision dairy farming, big data analytics, artificial intelligence, and the internet of things with the aim to accomplish a near real-time, data-integrated, data-driven, continuous decision-making engine through which management decisions can be better informed by integrated data streams to improve the economics of the farm and to positively benefit the individual animal and the overall farm through descriptive, predictive, and prescriptive analytics. Within this general concept, we have developed a machine learning hybrid K-medoids, random forest and support vector regression (K-R-S) approach for predicting the lactation curves of individual primiparous cows within a targeted environment using monthly milk production data from their dams and paternal siblings for 6,400 calves born in Wisconsin farms in year 2016. Our K-R-S hybrid approach outperformed the mean of paternal siblings in predicting first lactation test-day milk yield of primiparous cows 74.2% of the predictions. The algorithm has the ability to predict all data points required to construct primiparous cows’ full lactation curves even before they have started their productive life. Our approach allows the genotype-by-environment interactions to be portrayed in the prediction algorithm. Our current model uses only test-day (monthly) production data, but the artificial intelligence architecture is prepared to accommodate more frequent farm records (e.g., daily milk records from milking parlor) or other phenotype measures such as reproductive or health parameters for better characterization of the animals and their production environment towards improved prediction accuracy. We envision the prediction architecture will serve as an engine of farm-specific continuous prediction relaying on a constant flux of integrated data from different farm data sources following the Dairy Brain notion of data integration, analytics, and decision making.

Keywords: machine learning, prediction models, lactation curves

Genetics and Genomic Approaches for Sustainable Dairy Cattle Improvement in Smallholder Dairy Systems.
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Abstract: This study examines genetic and genomic approaches for sustainability in the dairy systems of developing countries of sub-Saharan Africa, where farms are predominately managed by smallholders, with 80% of land holdings being smaller than ten hectares. Sustainability in these systems involves addressing the global challenges of climate change while ensuring food security. Feed intake is a major trait with huge impact on both the efficiency of small holder systems and on methane emission. Improvement in feed efficiency will both mitigate the effects of climate change and reduce the cost of milk production. Body weight provides an indirect means of improving feed efficiency for body maintenance. Using daily milk yield and body weight records for 2716 cows, genomic predictions were undertaken, and a selection index for improving milk yield while restricting changes in body weight was implemented in Tanzania. However, defining broader breeding goals continue to be a challenge due to the lack of data but collection of milk components and somatic cell counts is being piloted in Tanzania and Ethiopia. Breeding for heat tolerance has been based on the rate of decline in milk yield due to changes in the temperature and humidity index (THI). An analysis of 14,367 daily milk records of 3511 dairy cows and weather records in Tanzania indicated that heat stress significantly affected daily milk production and reduced milk yield by 4.16% to 14.42% across THI groups. Reaction norms for sire EBVs along the trajectory of THI indicates that genetic variations exist which can be used to select animals that perform optimally in different environments. Also, other indicators of resilience including log-transformed variance and skewness of deviation, based on fluctuations in animals’ milk yield have been examined. Cows with less than 50% of exotic dairy genes showed significant levels higher degree of resilience.

Keywords: small holder dairy systems, heat tolerance, sustainability