A framework for predicting the environmentally attainable intake of dairy cows

J.F. Ramirez-Agudelo, Laurence Puillet, Nicolas N.C. Friggens

Poster 19.21

A framework for predicting the environmentally attainable intake of dairy cows

J.F. Ramirez-Agudelo, L. Puillet, N.C. Friggens

Université Paris-Saclay, INRAE, AgroParisTech, UMR Modélisation Systémique Appliquée aux Ruminants, France

nicolas.friggens@agroparistech.fr

Introduction

Predicting Intake Under Constraints:

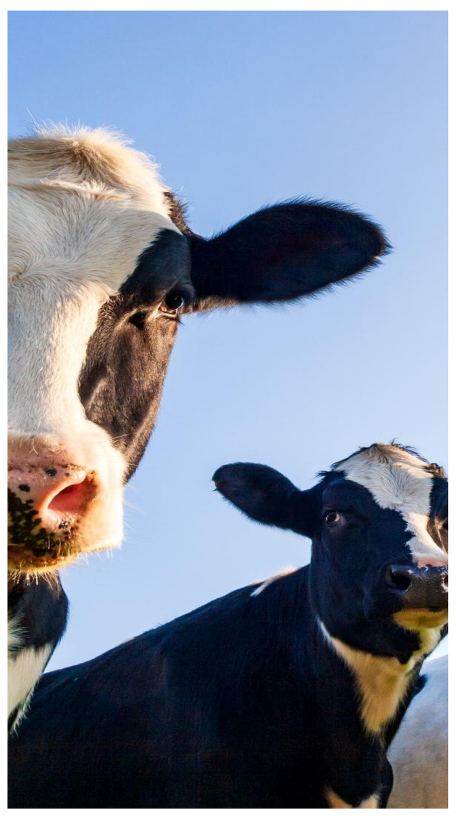
- Essential to estimate intake under environmental limitations, e.g., climate change

-Assumptions in Traditional Intake Models:

- Normal farm conditions with free access to food.
- Intake is either based on animals' full potential or limited by feed quality.

Using Mathematical Models:

- Alternative to direct intake measurements.



Environmentally Attainable Intake (EAI):

- Framework to predict dairy cows' intake under environmental constraints.

Framework's Approach:

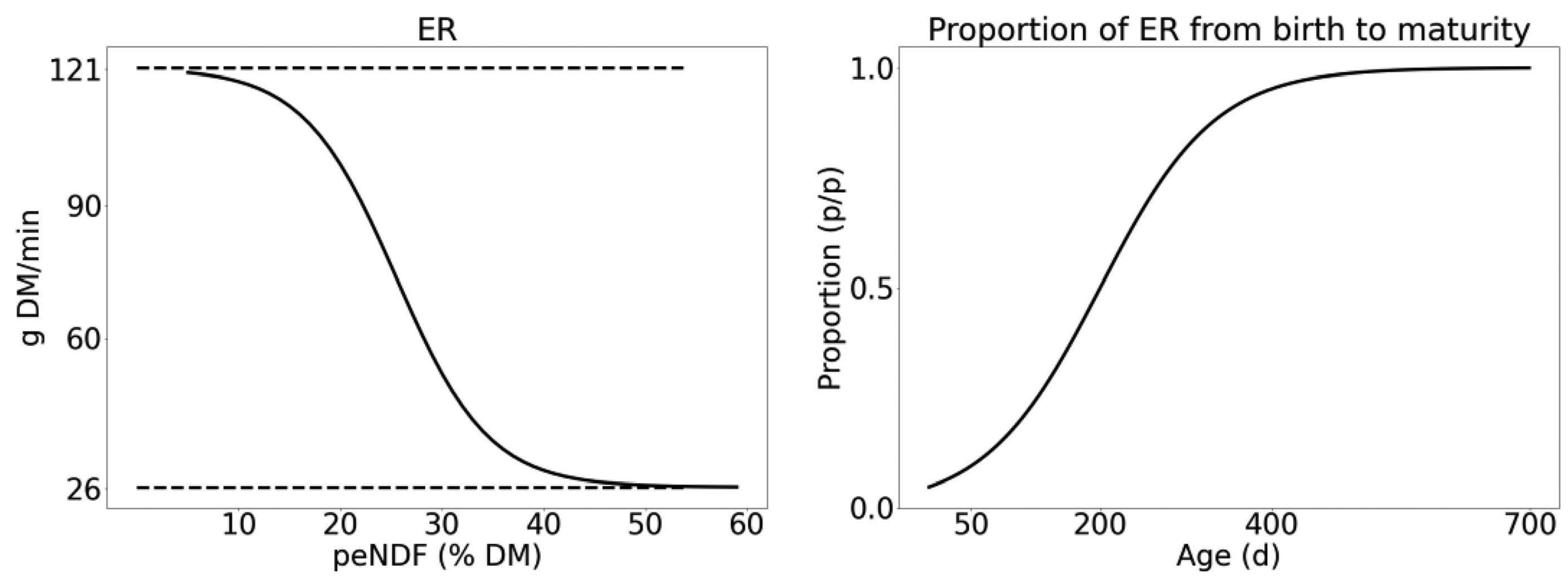
- Calculates Eating Rate (ER) and Eating Time (ET).
- EAI = ER x ET

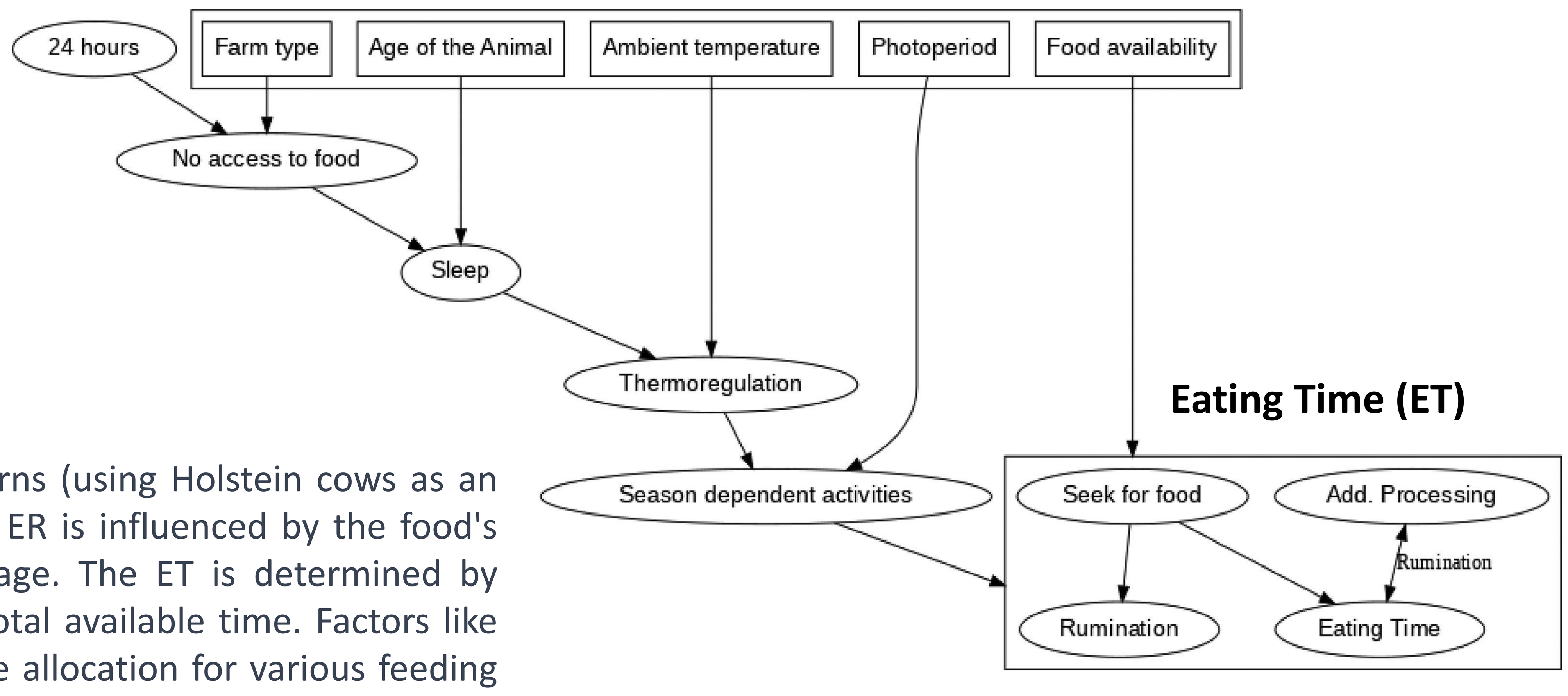
Framework's Potential:

- Aims to be a complementary tool for situations with environmental feeding restrictions.

Methods

Eating Rate (ER)





Simple conceptual framework with accuracy in predicting actual intake patterns (using Holstein cows as an example), and flexibility to include additional environmental constraints. The ER is influenced by the food's fiber content and the animal's oral capacity, which in turn is affected by age. The ET is determined by subtracting non-feeding activities, like sleep and farm operations, from the total available time. Factors like heat stress, season-dependent activities, and food availability impact the time allocation for various feeding activities.

Results

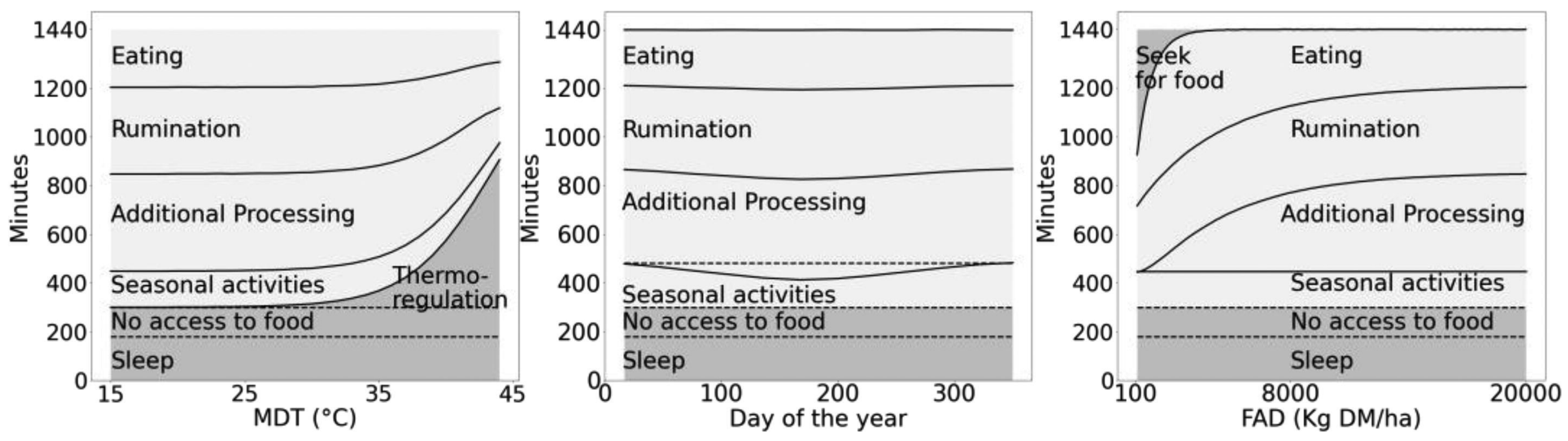


Figure: impact of heat stress, seasonal variation, and food availability on daily activities. On the left, as the temperature (MDT) exceeds 25°C, thermoregulation time rises, leading to decreases in ET. The central graph highlights that in the northern hemisphere, ET rises in summer due to seasonal changes. The right-hand graph indicates that the time spent searching for food increases when food is in short supply, while processing time expands with greater food availability.

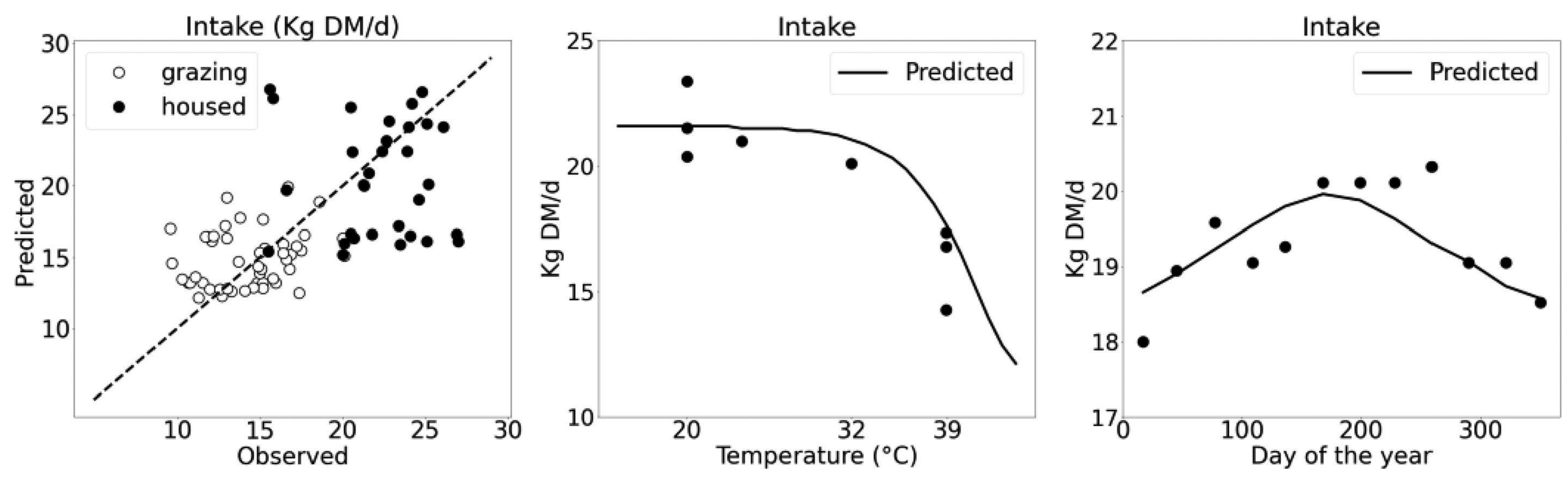


Figure: three plots contrasting observed intake from various sources with the EAI calculated by the framework. The left plot compares intake data from several papers, the middle one focuses on intake from heat stress studies, and the right one juxtaposes intake data from Munksgaard et al. (2020) against EAI throughout the year.

Discussion and Conclusions

While past models have considered environmental factors like fill or thermal stress, this framework combines various environmental factors that impact the time budget available for eating. It emphasizes the importance of distinguishing between EAI and the intake required by an animal's genetic potential. The framework is designed to be simple, adaptable, and considers environmental stressors like heat, and daily activities such as resting and seeking food. It ultimately aims to offer a more holistic prediction of intake in various conditions. More details at: doi.org/10.1016/j.animal.2023.100799

The time-based framework predicts intake in constrained environments for both grazing and housed cows, with mean absolute errors of 2.4 and 4.2 Kg DM/d, respectively. The framework can help study animal performance in constraining environments, allowing breeders to improve breeding programmes to face future adversities, and farmers to evaluate management strategies that optimise animal production, especially time-dependent decisions.

INRAE UMR MoSAR AgroParisTech GENTORE