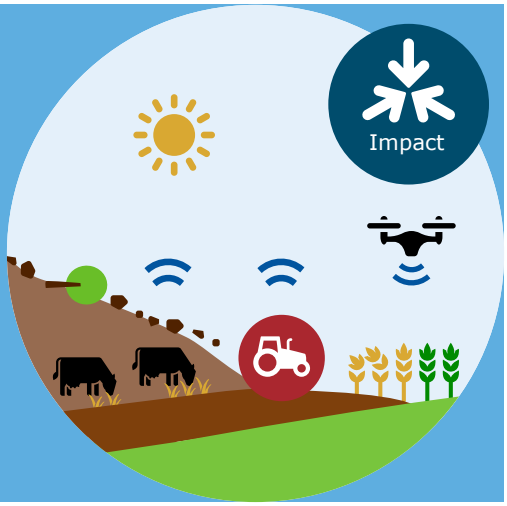
Discover the impact of climate change on dairy cow welfare using high-frequent behavioural sensor data

Emerging DS/AI methods



WAGENINGEN
UNIVERSITY & RESEARCH

Data Driven Discoveries in a changing climate (D3C2)

Objective: The aim of this project is develop a data-driven methodology to quantify the effects of heat stress in dairy herds.

Activities

In this project, we used on-farm sensors to collect data to quantify long-term impact of heat stress on production, fertility and health of dairy cows. After setting up the modelling group, we started with the analysis and modelling of historical data from a Belgian robotic dairy farm and the Dutch dairy research facilities of Wageningen University & Research. Next to this, we agreed what sort of model is needed to identify and quantify heat stress effects on the animals. We also thought about how we can separate, for instance, heat stress sensitivity of a group or of an individual animal. The model we developed, is general enough to apply it to several data types, such as activity data, time-budgets spent in different zones in the barn, milk production. It allows to understand herd, individual, and covariate-related effects such as the impact of parity or lactation stage of the animals.

With the model, we looked at the behavioural changes due to heat stress. We could also analyse the different layers of the data, which is a novel approach. As such, we were able to separate timely effects (at the moment of heat stress) and time-lagged effects (during the heat stress recovery period). This allows in the current 2023 project to quantify whether and how much the animals are affected by the climate events. This resulted in quantitative information that can be used for monitoring, individual mitigation and treatment by adjusting the management of the cows. Behavioural indicators can highlight which animals need more attention during climate events, and which cows are suitable to their farming/management environment and therefore best potential breeding candidates.

Achievement

In this project, we could nicely exploit and bring together knowledge in different domains. First, with the models we were able to explicitly quantify the behaviour and production changes for cows experiencing heat stress, based on sensor-time series data, and considering both the group and individual baselines for these behavioural parameters. Additionally, by approaching a physiological problem with data-driven approach, this allowed to formulate ways to explicitly use on-farm available data for decision support in a changing climate. This way, information from data streams can be exploited better and added value is created.

Interpretation of the data was not possible without thorough data exploration, and explicitly considering what patterns we were after. Our expert knowledge allowed to formulate a generally applicable model that provides insight in the different layers of the problem. Thereby, we took both time and individuality of the cows into account.

Outlook

A follow-up proposal has been granted in 2023, which builds on the results of 2022. Ideas of preliminary research in 2022 were also included as case study in a personal

three-year fellowship at the University of Ghent, Belgium. This focusses on the link between domain knowledge and data-based (time-series) modelling in the animal domain. Furthermore, we established collaboration for data and knowledge exchange with KU Leuven (Belgium), RAFT Solutions Ltd. (United Kingdom) and UniPD (Italy).

Deliverables

- Abstract of the project is submitted to EAAP Lyon 2023.
- Presentation at PLF workshop Copenhagen 2023.

Lessons learned

This project has confirmed that farming data is always complex, and expert knowledge is needed to create added value for its use and interpretation.

The internal collaboration went well, and the connections we established for data exchange are and will be valuable for future work. As we connected to groups from different countries throughout Europe, different environments could be included in the research, also valuable for future work.

The project team's expertise was diverse, and to understand the data, we needed to communicate well on what is 'normal', 'expected', 'technical errors' or other in the data among the 'domain' and 'data' experts. That dialogue can be challenging at times. As we found that a research paper would be too early, and we can continue the work in 2023, we decided to combine the results of 2023 and 2022 in one manuscript.

In the beginning some time was lost because of the complexity of the data, and because it's crucial to get to know and clean the data thoroughly before modelling. This is not evident when the domain knowledge is yet to be acquired. Therefore, we could only work on two farms, while the data agreement and data availability encompass more than ten farms in different environments. Luckily, we can continue the work in 2023 and use the lessons learned and expertise acquired for the new project.

Contact

Ines Adriaens
Researcher Animal Breeding and Genomics (project manager)
ines.adriaens@wur.nl

Wageningen University & Research
P.O. Box 47
6700 AB Wageningen
The netherlands
T +31 317 48 07 00
www.wur.eu

Project members
István Fodor
Marjaneh Taghavi
Roxann Rikkers