SUGGESTIONS FOR HORIZON EUROPE (FP9)

BY THE EXECUTIVE COMMITTEE OF THE FEED-A-GENE PROJECT

Feed-a-Gene

OCTOBER 2018

SOME THOUGHTS ABOUT PROJECT DEVELOPMENT AND EXECUTION

Feed-a-Gene is a Horizon 2020 project funded under the call for sustainable food security. The objective of the project is to "Adapt the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems". This short note expresses the views and opinions of the Executive Committee of the Feed-a-Gene project on what we feel as important topics to be addressed in the next framework program Horizon Europe.

Ensuring a sustainable food supply in Europe is a complex issue and calls for a multidisciplinary and multi-actor approach. To facilitate integration within the project and to ensure societal uptake and impact, we feel that the objective (and object) of future projects should be focused and question-oriented, which should be addressed at different levels. The innovation potential of projects could be improved by allowing future projects to be somewhat "open-ended" (in terms of ideas and resource allocation) based on new insights and results obtained during the first years of the project.

DIVERSIFICATION OF FEED RESOURCES: FROM ONE TO MANY

Increasing the protein autonomy in Europe and development of the circular bioeconomy are important issues in terms of food security and environmental impact. Technological processes can be used to produce multiple feed ingredients with different chemical, functional, and nutritional properties from a single source (e.g., separation of different fractions of European grown soybean or rapeseed meal, or "cracking" of green biomass). The diversification of feed resources from a single source provides a great potential to make better use of the source material because the different end-products can be used in different segments of food and feed chains, and would allow to reinforce the role of livestock as converters of byproducts. The process of fractionation is, of course, not new (e.g., oilseeds are cultivated to produce oil for human consumption or as biofuel and oilseed meals for animal nutrition). However, to make efficient use of the raw material and of the land on which it is cultivated, a chain-approach is required in which the different agronomical, technological, and nutritional aspects are addressed through all dimensions of sustainability.

EXPECTED IMPACTS

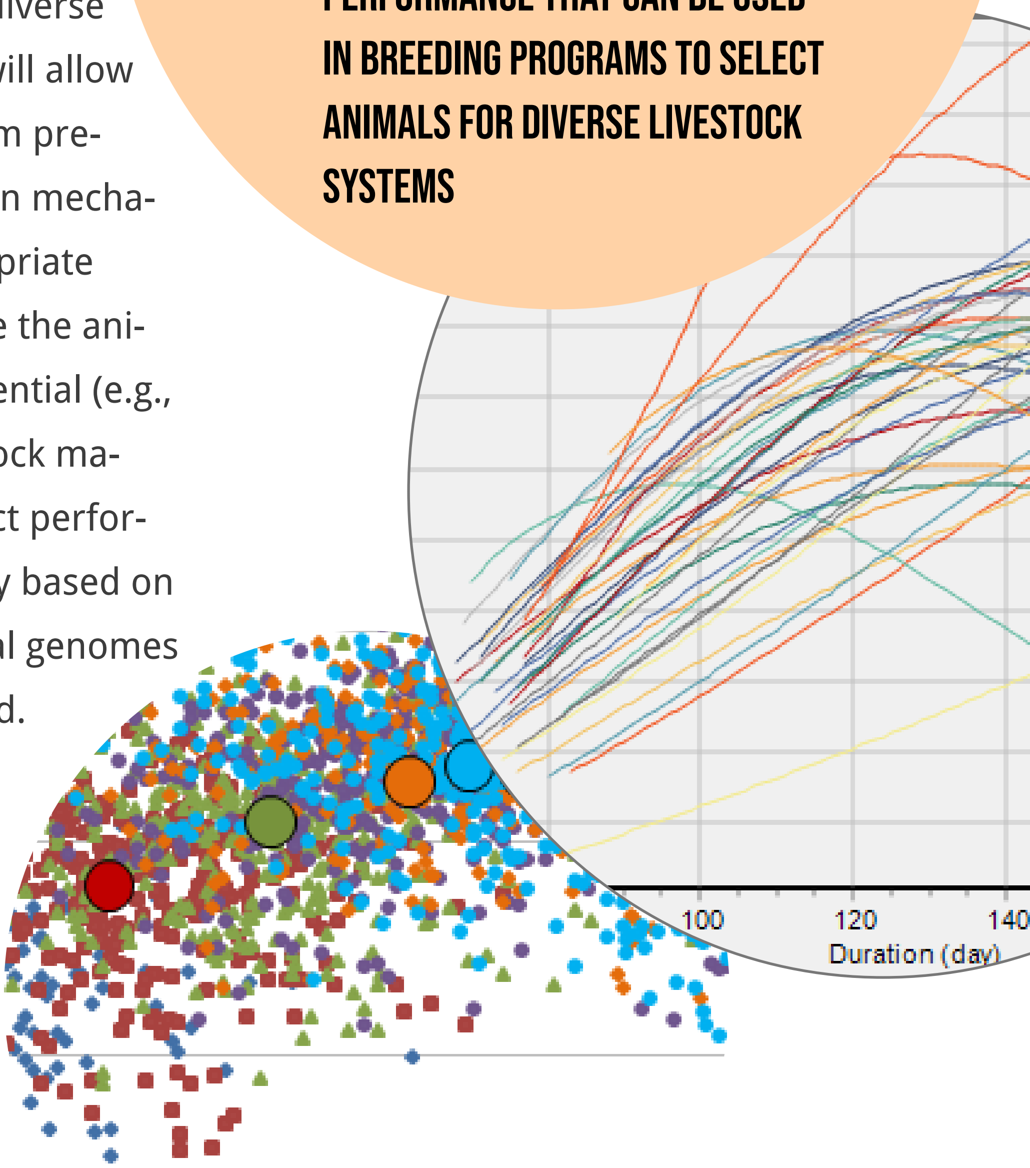
- INCREASED PROTEIN AUTONOMY IN EUROPE
- OPTIMIZED USE OF BIOMASS (AND OF THE ARABLE LAND ON WHICH IT IS CULTIVATED) IN DIFFERENT SEGMENTS OF THE FOOD CHAIN

DATA ANALYSIS AND MODELING: WHERE BLACK MEETS WHITE

We have entered an era in which our capacity to observe is increasing exponentially. This ranges from very basic aspects of biology (e.g., gene sequencing and gene expression) to phenotypic and phenomenological observations on (groups of) individual animals and on livestock production systems. Data analysis techniques such as data mining identify patterns and structures in very large datasets that can be used for predictive purposes. These techniques consider the object of study somewhat as a black box, which contrasts with mechanistic modeling approaches in which knowledge of underlying biological mechanisms is used to simulate and understand the behavior of a system. Both approaches have advantages and limits. Mechanistic models provide detailed and knowledgeable understanding of the biological responses in situations and conditions under which the model was developed. Although mechanistic models use data for model evaluation, they lack the capacity to accommodate very large and diverse datasets. Data mining do not provide biological explanations, but can provide good predictions, even in situations that were not encountered before. Integration of both approaches provides an opportunity to accommodate knowledge of biological phenomena (through mechanistic modeling) with the predictive and analytical capacity (through data mining) using very large data sets. It will fill the gap between the physiological description of known mechanisms, and the need to analyze the performance of very large numbers of animals in very diverse production systems. It will allow detecting deviations from predictions (based on known mechanisms) to provide appropriate solutions and to manage the animal according to its potential (e.g., through precision livestock management) and to predict performance of future progeny based on combinations of parental genomes that are not yet observed.

EXPECTED IMPACTS

- A BETTER UNDERSTANDING OF THE BIOLOGICAL BASES OF VARIATION AMONG ANIMALS
- A BIOLOGICALLY MORE SOLID BASIS TO ANALYZE AND PREDICT ANIMAL PERFORMANCE THAT CAN BE USED IN BREEDING PROGRAMS TO SELECT ANIMALS FOR DIVERSE LIVESTOCK SYSTEMS



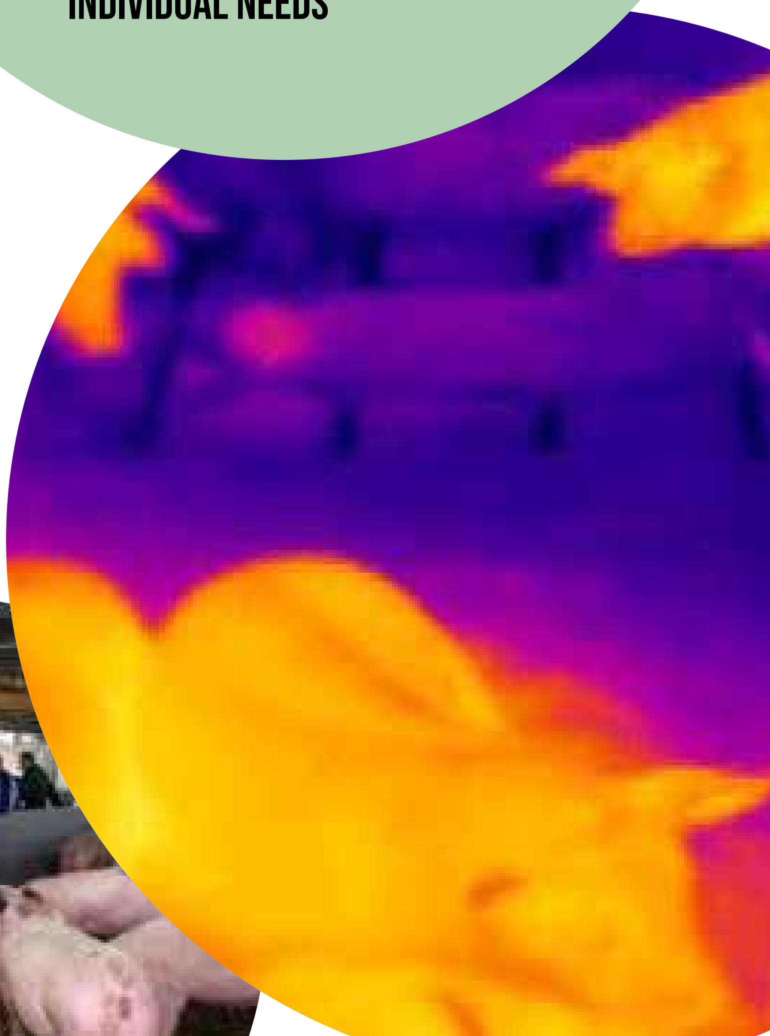
INTEGRATION OF TECHNOLOGIES TO IMPROVE THE SUSTAINABILITY OF LIVESTOCK PRODUCTION SYSTEMS

The rapid development of sensors and monitoring technologies provides an opportunity for livestock production. Precision livestock farming relies on data from various sources, which are analyzed and integrated, resulting in recommendations and automated control actions in livestock management (e.g., feeding, medication). Precision livestock farming has a great potential in terms of resource utilization, feed costs, and environmental impact. It also considers animals more as individuals and less as one-of-a-group. This is already the case for larger animals such as cattle and pigs, and it is likely that this will be the case for smaller animals in the future as well.

Developments in precision livestock farming have focused mostly on a specific area (e.g., feeding or health management), but the diversity of information that can now be obtained from animals and from their environment calls for a more integrated approach. Precision livestock farming also changes the existing selection paradigm, which considers the animal's environment as fixed, and not tailored to the animal's individual needs. Integrating information from the animal's background (e.g., through genetic relationships or genomics data) with information on the animal and its environment originating in real time from sensors and monitoring technologies can be used to develop personalized nutrition and care for animals. A multi-actor approach in which different elements of precision livestock farming systems are integrated, further developed, and demonstrated is required. Actors should include researchers, industry, farmers, and citizens. Trade-offs between the benefits of precision livestock farming (e.g., improved resource efficiency, reduced environmental impact, personalized animal nutrition and care) and limitations (e.g., acceptance by farmers, perception of citizens) should be addressed.

EXPECTED IMPACTS

- REDUCED USE OF RESOURCES (E.G., FEED, MEDICATION) IN LIVESTOCK PRODUCTION AND LOWER ENVIRONMENTAL IMPACT
- IMPROVED ANIMAL WELFARE BY ADDRESSING THE DIFFERENT DIMENSIONS OF THE ANIMAL'S INDIVIDUAL NEEDS



ROBUSTNESS AND EFFICIENCY WHEN THERE IS NO "ONE-SIZE-FITS-ALL"

Variation among animals and livestock production systems, differentiation of products, and segmentation of markets are important aspects of a sustainable supply of animal-derived products. This variation, differentiation, and segmentation is managed at different levels and by different stakeholders. For example, variation among animals is managed by genetic programs and by management practices of the farmer, while variation in products and markets is managed by farmers, retailers and consumers. Efficiency and robustness are nowadays seen as important aspects of a system, but having efficient and robust elements in a system (e.g., animals) does not necessarily mean that the livestock production system as a whole is efficient and robust (e.g., to fluctuations in market conditions). In addition, efficiency and robustness at the animal level are often considered for a specific trait, and this efficiency and robustness cannot necessarily be extrapolated to other traits.
To understand how efficiency and robustness are carried over from one level to another, a limited number of existing and contrasted livestock production systems should be analyzed as case studies. Proposals should address efficiency and robustness at all levels of the system (i.e., from markets and products arising from the

systems down to its constitutive elements such and animals, feed, arable land, and labor).

EXPECTED IMPACTS

- IDENTIFICATION OF AREAS IN WHICH THE EXISTING CASE-STUDY SYSTEMS CAN BE MADE MORE EFFICIENT AND ROBUST
- A SOLID UNDERSTANDING TO PROPOSE AND DESIGN NOVEL (ELEMENTS OF) LIVESTOCK PRODUCTION SYSTEMS

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