FABRE-TP

Research priorities on Animal Breeding and Reproduction for Horizon Europe

Driving innovation in Animal Breeding and Reproduction to benefit current and future generations

The Farm Animal Breeding and Reproduction Technology Platform (FABRE TP) is an industry-led forum. It provides a framework for stakeholders to define research priorities and action plans for the farm animal and reproduction sector in order to achieve EU growth, competitiveness and sustainability through major research and technological advances in the medium and long term.

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1. Introduction

The aim of this document is to provide inputs to important research topics within the field of animal breeding and genetics for Horizon Europe. Animal Breeding and Genetics contribute to efficient and sustainable food production in Europe by improving the traits relevant to sustainability in the animal populations that are raised in the EU. This will be achieved by combining technology and biological knowledge of the given species within the framework of economics and social science.

2. Contribution of Animal Breeding and Genetics to increased sustainability of the food system in the EU - input to Horizon Europe from the R&D and industry sectors

Livestock farming is currently challenged, due to an overvaluation of its negative impact on the environment and on animal health and welfare issues. Indeed, current farming practices were set up and optimized during the last 50 years mainly towards the objective of increasing productivity, leading to intensification and specialized breeds. Intensification livestock systems has been associated with an increased use of fossil energy, fertilizers and biocides. Eliminating livestock products from diets is sometimes proposed as a way to reduce our environmental impact on the planet. This, however, overlooks all the benefits and values of livestock farming and the negative impact to the environment of agricultural systems without animals, where a circular bioeconomy would be impossible.

Indeed, the European livestock sector is **crucial for European Food and Nutrition security**, providing meat, dairy products, eggs and seafood which are a source of high-quality proteins, amino acids and micro-nutrients essential for human growth and health. **Animal products are an essential part of healthy diets**. Furthermore, it contributes substantially to the European Circular Economy and to the vitality of great diversity of European territories and landscapes, while being amongst the best in the world in terms of low environmental impact, high animal well-being as well as high quality and safety of the products. Altogether, European livestock production contributes directly to 6 of the 17 Sustainable Development Goals (SDGs) as defined by the FAO.

- **SDGs 2** (*Zero hunger)* and **3** (*Good health and well-being*) by selecting animals producing high quality food
- **SDGs** *1 (No poverty)* and *8 (Decent work and economic growth)* by their economic impact on rural European territories (direct employment & services...)
- **SDGs** *12*

Figure 1: Contribution of livestock farming to UN SDGs (European case in Blue, world level (blue and green)

(Responsible consumption and production) and *13 (Climate action)* by improving the efficiency of production e.g. using less feed to produce more high-quality protein and improving animal health, all of which results in reduced GHG emissions.
- **SDGs** *15 (Life above land)* by a responsible management of genetic resources to maintain biodiversity. Livestock plays also a role to maintain rural landscapes and nature management.

As stressed in the ATF 2019 vision paper, **the agri-food systems** including livestock, need to be more circular and more sustainable and resilient, that implies also (re)connecting livestock and plants (grass, crop) production to achieve synergies and higher performance while reducing inputs and impacts. Any proposals to remove animals from the agricultural systems of Europe, threaten the concept of a circular bioeconomy. Climate adaptation and the role of livestock to maintain and improve biodiversity in farming systems is crucial. The European Green Deal, the Farm to Fork strategy, the Biodiversity Strategy and Horizon Europe should provide legal framework, policy and research tools to livestock and animal breeding to respond to these global challenges and develop a more sustainable agricultural and livestock production system. The success of a more sustainable food production depends on the balance between systems respecting the animals, the Earth and the people, including the income of the farmers and food producers.

Animal breeding and genetics are a part of the solution to ensure the transition towards a more sustainable EU food sector. Genetic improvement was a key factor in the last 50 years, adapting animals to the current farming systems that we have today; and this has led to huge progress in terms of efficient use of natural resources and high quality and quantity. *More recently, other traits like animal health and welfare, greenhouse gas emissions and adaptation to a larger diversity of farming systems* have been added to breeding goals and breeding programs. For instance, genetic selection has increased milk yield by 100kg/year in Holstein cows **and** the addition of selection for mastitis resistance has reduced by 3.8% mastitis frequency in 10 years, reducing milk waste and antibiotic treatment. **Genetics will undoubtedly contribute to adapt animals to the future sustainable systems**, assuming that breeding goals are clearly defined for all relevant and potential future farming systems and consumer demands.

The development of genomic selection can speed up the process of building more sustainable systems and by reaching new breeding goals. This can be complemented in the future with a better knowledge of the **genome, epigenome, microbiome and their interactions** to refine the genomic selection tools, increase their efficiency and extend their usability beyond current species and major breeds. Other tools and technologies to collect, manage and use data, new phenotypes, new breeding techniques and reproduction techniques can also help to better adapt and improve breeding in this changing world.

3. How research can answer to the challenges of European Livestock and Food Sector

Universities, research institutes, breeding cooperatives and breeding companies which are the members of FABRE TP have a recognized expertise in genetics, genomics, epigenomics, microbiota, reproductive physiology and biotechnologies. They can provide knowledge, methods and technology to setup innovations in a broad scope of topics directly or indirectly associated with their core interests. The system approach becomes evident for all researchers to tackle current and future challenges. Noteworthy knowledge, challenges, issues and technologies vary largely among species, breeds and countries. It includes the improvement and development of innovative reproductive technologies.

Priorities for Horizon Europe should be focused on the following issues:

> *a. New and diverse farming systems and related key traits should urgently be defined.*

A precise description of environment, housing conditions, feed & nutrition strategy is a prerequisite to define relevant breeding goals. At the same time, knowledge of the animals' capabilities and adaptability are necessary to harmonise their demands and environment. Evaluation of genetic resources and elucidation of genotype-environment interaction will contribute to the sustainability, profitability and functioning of diverse farming systems. Genetic resources management should also be renewed in light of these novel requirements, e.g. resilient/robust animals performing well in a large variety of environment *vs* system specific breeds, dairy and beef breeds, egg/poultry meat breeds *vs* dual purpose breeds, purebred *vs* crossbreed…

This could only be achieved by a multi-disciplinary and multi-actor approach, gathering breeders, farmers, zootechnicians, nutritionists, geneticists, economists, ecologists, veterinarians, sociologists, NGOs and policy makers. Relevant key traits, including innovative ones should be promoted and their economic impact should be evaluated. More knowledge on how to handle goal conflicts, e.g. between animal welfare, GHG emissions and biodiversity are needed, together with increased understanding of breeding organizations' possibilities to facilitate the fulfilment of the SDGs.

Social issues related to animal production should be taken into account when defining new breeding goals and designing new breeding programs. Furthermore, social acceptance should be an inherent factor of the redesign of new technology or systems in order to improve public perception about animal production.

Multi sector projects and experiments might be of interest when it comes to co-select plants and animals and to diversify farming systems in order to improve the global efficiency of the system and improve sustainability.

> *b. Phenomics (new phenotypes, proxies and technologies) is needed to tackle current and future challenges.*

Climate adaptation and mitigation, disease resistance, better use of resources, products quality (organoleptic and technological quality) and animal welfare are still under-explored, mainly due to the lack of easy to measure phenotype and/or cost effective and convenient technologies. In addition, novel technologies and proxies provided by various disciplines will probably be required to define and measure traits associated with novel farming systems and scenarios, taking into account species and regional specificities. This may include new technologies to measure current traits that could not be measured in a new system, e.g. when animals are not kept inside/alone). Research should thus first focus on defining the phenotypes underlying mechanisms of traits and the farming system characteristics and on deriving proxies and biomarkers as a basis to develop appropriate on farm technologies, including sensors, for routine monitoring of phenotypes. This should be done taking social sustainability issues and cost/benefit ratio into account. In particular, R&I development of biomarkers and corresponding *in vivo* biosensors for continuous monitoring of molecules of interest (e.g. hormones, metabolites) could help monitoring animal welfare & health and reducing the ecological footprint of livestock.

> *c. Knowledge on genome and microbiome functioning is required to improve genomic selection and set up precision breeding tools.*

Current genetic markers and methods explain only part of the expected heritable fraction of complex traits and diseases. Several hypotheses have been drawn to explain this so called "missing heritability", but the issue is still open. New markers (mitochondrion, microbiota, heritable epigenetic markers…) and new methods are still required to improve reliability of both genetic evaluation and prediction of individual performances. A further key challenge is to extend genomic selection beyond current

species and major breeds, that will e.g. require the *in-silico* identification of causative mutations and a precise knowledge of gene and GxE interactions.

To achieve this goal starting from whole genome sequences, efficient algorithms are needed to predict the impact of a given mutation on traits or phenotype. Genome Editing may prove to be a powerful tool to gain a comprehensive knowledge of phenotype - gene or mutation association. Likewise, a better knowledge of epigenome and microbiome is also required, including epigenetic effects of nutrition and the impact of nutritional programming. Environmental enrichment provided to parent animals could have positive epigenetic effects on the next generation and thereby improve animal welfare of large numbers of production animals. Increased understanding of the microbiome's influence on animal behavior (e.g. feather pecking) and product quality (e.g. boar tainted meat) could lead to a new selection trait: Ability to host a favourable microbiome.

Taking advantage of current efforts and growing knowledge of genome annotation, research is needed about the impact of specific nutrients as well as novel and alternative feed stuffs, particularly useful for reducing competition of feed and food, on epigenetic marks and gene expression. Moreover, effects of feed and feeding management on microbiota composition need to be linked to microbial functional properties in order to estimate consequences for the host.

> *d. Statistical methods and Decision Support Tools based on Big Data are required to improve sustainability.*

In conjunction with the development of biomarkers (molecular, infrared spectra…), robots, videos and high throughput technologies (including sensors) providing a wealth of (real time) data, methods are required to make the most of them and develop holistic approaches. This includes guidelines to **standardize** the data at the European level, "big data" statistical methods to integrate on farm data at several levels (farm, animal, tissue, molecular data) and data from the environment. This is a key for the development of Decision Support Tools and reducing farm environmental footprint, improve animal management practices, prevent diseases and improve animal welfare. In particular, support is needed to link climate data with disease occurrence (especially emerging zoonoses associated with climate change) and reproductive efficiency.

4. Projects' configuration across clusters and missions

Horizon Europe address the main EU research challenges by clusters and missions. Animal breeding and reproduction are key across a number of these, playing a huge rule in mitigation and adaption to climate change, in human and animal health and well-being, in rural and coastal life areas and the future of the planet to provide high quality and safe food. FABRE TP deems it necessary to have different kinds of projects, in terms of configuration and size, depending on the challenge(s) that requires to be tackled.

> *a. Types of projects.* Both basic and applied science are seen as important by the animal breeding and reproduction sector, as well as the collaborative research between the private sector and knowledge institutes. In addition, focused calls such as small follow-up projects of larger projects are also needed. It is also true that some issues could be tackled effectively by smaller projects with less partners.
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> *b.* **Dissemination and exploitation of results in projects should be given more emphasis and importance**. The place given to these activities should be more important and supported for a fixed period of time even after the end of the project, in order to guarantee the best involvement of researchers and stakeholders in the spread of the outputs, knowledge and expertise delivered by the project aiming to take the impact one-step beyond the expected. The stakeholder role should also be enhanced by increasing their funding for the human

resources allocated to the follow-up of the projects, especially in the bigger ones in order to enable and increase the flow of information and knowledge between the private sector and the research teams beyond the project lifetime. It is also possible to enable and support Community Creation by a cluster of projects working in the same field for related objectives and finance these initiatives separately in order to facilitate and enhance the dissemination and uptake of outputs by the end-users. Therefore, the projects in the cluster could still reach out the stakeholders even after the lifetime of the project through these cluster events.

c. ***Collaboration outside Europe.*** The European Breeding sector has enormous skills, knowledge and expertise. Collaboration with other countries to spread these skills can help to make international science and livestock smarter, whilst respecting and improving local breeds in third countries and keeping genetic resources. Human well-being in developing and poorer countries could be improved by livestock activities and responsible animal breeding.

d. ***Responsible research and innovation projects:*** RRI should be at the core of every project and research conducted in Europe, but in the case of animal breeding, specific calls should be dedicated to technical, legal, ethical, societal and communication issues in the next Horizon Europe program, separately for other topics related to animal genetics.

For instance, Genome Editing could be an additional tool in the breeders' toolbox, but more research is needed before its integration in current breeding programs. In the meanwhile, attention should be paid on the legal aspects in Europe, as well as ethical, societal and communication issues and covering both plants and animals. Likewise, a call focused on enabling technologies would be relevant to address technical issues of genome editing.

5. FABRE TP

The Farm Animal Breeding and Reproduction Technology Platform (FABRE TP) promotes research and innovation for sustainable animal breeding and reproduction in Europe. FABRE TP is the main contact point for farm animal breeding and reproduction organisations in Europe, aiming to mobilise the research efforts, technological development and innovation efforts in Europe. We bring together key stakeholders around a common vision for the development of technologies and practises around farm animal breeding and reproduction. FABRE TP started as an initiative of pro-active partners in breeding in 2005, then continued as an EC funded project in 2006, and is since 2009 an official [European Technology Platform](#).

- Promotes sustainable farm animal breeding and reproduction in the EU
- Develops research and innovation agendas and sets priorities
- Connects industry, knowledge institutes and policy
- Supports innovation

6. Membership of FABRE-TP

2019 membership of FABRE TP is composed by 32 Knowledge Institutes and 43 companies.

Breeding and reproduction organisations

EFFAB — European Forum of Farm Animal Breeders

AHDB

Allice — ÉLEVAGE | INNOVATION | SERVICE

Aviagen

Benchmark®

feagas — FEDERACIÓN ESPAÑOLA DE ASOCIACIONES DE GANADO SELECTO

CRV

FBF

Genus

GROUPE GRIMAUD — Caring for life

HENDRIX GENETICS

GLOBALG.A.P.

AquaGen

MSD Animal Health

ANPS

SEGES

Alta

Cherry Valley®

cogent

LOHMANN TIERZUCHT

ifip — institut du porc

geno

VÖS — Verband Österreichischer Schweinebauern

Cobb®

figen

MOWI®

Topigs Norsvin — PROGRESS IN PIGS

ASR — Arbeitsgemeinschaft Schweizerischer Rinderzüchter — Communauté de travail des éleveurs bovins suisses

ICBF.com

PIC® Genetics — Hermitage AI

awe — association wallonne de l'élevage

SYSAAF

VIKING GENETICS INTERNATIONAL

ANAFIJ

SEMEX® — Genetics for Life®

ZAR — RINDERZUCHT AUSTRIA

ANDRIMNER — GENÉTICA APLICADA

DNA GENETICS

ALTIUS — advocaten / avocats / lawyers

Osemenjevalni center — PRESKA

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