

## INRAE's contribution to the European Commission's consultation on the EU Strategy for livestock

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### EXECUTIVE SUMMARY

**INRAE**, the French National Research Institute for Agriculture, Food and Environment, welcomes the European Commission's initiative to develop a dedicated strategy for the livestock sector given the many challenges it faces: long-term viability, sustainable transition, animal welfare, as well as contributing to food sovereignty and the attractiveness of agriculture. We share below (and in the attached paper) our views and recommendations.

Designing sustainable, safe and economically attractive livestock systems will support the agroecological transition of agri-food systems and position livestock as a key contributor to One World-One Health. This vision feeds the INRAE's scientific priorities on livestock towards 2030 and beyond.

A truly European sustainable livestock strategy must be built upon the following crosscutting priorities:

- Maximize the positive contributions of livestock farming by considering benefits for food, bioeconomy and the environment, and reduce its negative impacts;
- Adapt to and contribute to mitigate climate change;
- Protect and improve farm animal health and welfare while preserving production capacities;
- Ensure economic and territorial vitality;
- Create socio-economic conditions conducive to the renewal of farmers and to improving farmers' quality of life;
- Interdisciplinary and trans-sectoral approaches combining life sciences, data sciences, humanities and social sciences.

In the attached paper, INRAE highlights research areas that are likely to deliver tangible European added value in transforming the EU livestock sector towards greater resilience, enhanced global competitiveness and improved economic, social and environmental sustainability whilst reflecting Europe's territorial diversity. These areas are:

- 1) Increase the multi-performance of livestock systems by making animal health, welfare and reproduction key drivers of competitiveness and societal advances.
- 2) Strengthen animal health facing climate change and environmental pressures.
- 3) Promote innovative systems for protein autonomy, circularity and bioeconomy, rooted in local areas.
- 4) Conserve, characterise and deploy genetic resources and support breeding to enhance resilience and competitiveness.
- 5) Connect animal production to the quality of animal-source foods.

**INRAE**, the French National Research Institute for Agriculture, Food and Environment, welcomes the European Commission's initiative to develop a dedicated strategy for the livestock sector. **Designing sustainable, safe and economically attractive livestock systems will support the agroecological transition of agri-food systems and position livestock as a key contributor to One World-One Health. This vision feeds the INRAE's scientific priorities on livestock towards 2030 and beyond.**

INRAE embraces the challenges identified by the European Commission that livestock is currently facing: declining herd numbers and farm closures; possible low profitability and weak economic viability; growing concerns about farmers' well-being with consequences on attractivity; adaptation to climate change; environmental and climate footprint; trade and market competition; animal health and welfare risks; uneven territorial impacts.

In this demanding context, a truly European sustainable livestock strategy must be built upon the following crosscutting priorities:

- Maximize the positive contributions of livestock farming by considering benefits for food, bioeconomy and the environment, and reduce its negative impacts;
- Adapt to and contribute to mitigate climate change;
- Protect and improve farm animal health and welfare while preserving production capacities;
- Ensure economic and territorial vitality;
- Create socio-economic conditions conducive to the renewal of farms and to improving farmers' quality of life;
- Interdisciplinary and trans-sectoral approaches combining life sciences, data sciences, and social sciences.

Below, INRAE highlights areas of research that are likely to deliver tangible European added value in transforming the EU livestock sector towards greater resilience, enhanced global competitiveness and improved economic, social and environmental sustainability whilst reflecting Europe's territorial diversity.

### 1) Increase the multi-performance of livestock systems by making animal health, welfare and reproduction key drivers of competitiveness and societal advances

Farm animals are facing growing pressures due to climate change, exposure to environmental factors and societal expectations. Integrating these pressures and mitigating the associated risks into livestock systems is a real 'adaptation challenge'; it can also be an opportunity to enhance the competitiveness and resilience of these systems if the solutions adopted enable them to simultaneously meet societal, economic and environmental expectations. To address this challenge, INRAE supports the transformation of livestock systems by deepening our understanding of the links between animal health, welfare and performances – including reproduction capacity – and by integrating these dimensions into multi-performing systems addressing economic, environmental and societal issues. Such integrative approaches rely on the joint study and assessment of (i) biodiversity, (ii) ecosystem functioning, with the increasing role of the microbiomes, (iii) infectious disease dynamics, (iv) animal and herd monitoring using digital tools and (v) agricultural practices at farm and territory scales. The mechanistic understanding of these interactions remains incomplete, and their translation into operational levers remains a scientific and methodological challenge, while there are likely to significantly improve the long-term competitiveness of the EU livestock sector.

**Recent scientific advances:** Better knowledge on microbiota-immunity-pathogen crosslinks; better understanding of interactions between livestock, wildlife, territories and climate change; progress in methane emissions reduction; alternatives to antimicrobial and other chemical inputs; assessment of emotional states through the AI-based detection and recognition of behavioural and physiological signals and alerts on animals; understanding of animals' cognitive abilities and emotions.

**Needs for further research:** Fundamental research to better understand the mechanisms underlying animal health and immune competence, welfare and reproductive capacity by considering fluctuant environments and exposition risks; research and

innovation on integrative approaches linking health, welfare, practices and environments; combining improvements in animal welfare with the farmers' well-being (One Welfare); translation of these results into operational tools and practices enabling a multiperformance improvement.

## 2) Increase animal health facing climate change and environmental pressures

Environmental pressures, whether direct (pathogens, heat stress, exposition to pollutants) or indirect (feed quality and availability), are sources of vulnerabilities for animals. In addition, climate change and international trade are increasing the frequency and spread of epizootic and zoonotic diseases, including through changes in vectors distribution. To improve crisis preparedness and ensure greater predictability and economic stability to farmers, INRAE develops preventive approaches to limit the impact of animal diseases (on human health, the environment, farm profitability, etc.). This requires improved surveillance, prevention and preparedness capacities, together with improved vaccination strategies. Understanding the trajectories of biological adaptation functions that rely on genetics, epigenetics, host microbiome interactions, physiological responses, and the identification of critical periods at individuals' and herds' scales will be an asset.

**Recent scientific advances:** Effective detection of pathogens and surveillance systems at national level, to be further enhanced through AI; innovative vaccine approaches (platforms, antigen design, targeted immune responses); new therapeutic solutions for infectious diseases affecting livestock; considering the individual genetic variability of response to pathogens and vaccines as part of the health and resilience strategy.

**Needs for further research:** Support research on (re)emerging pathogens; develop and coordinate early detection and surveillance systems through a dedicated European hub; create a European hub for veterinary vaccines as the one established for human vaccines, to accelerate innovation; better integrate animal health into public health preparedness and response frameworks for zoonotic risks (One World-One Health approach); support model, phenotyping and data development to understand how generic resilience and immune competence are related to responses to specific pathogens and stresses; develop resilience assessment and associated trade-offs and benefits at different scales (animal/herd/population/territory).

## 3) Promote innovative systems for protein autonomy, circularity and bioeconomy, rooted in local areas

INRAE promotes resource-efficient and circular management approaches (e.g., on-farm feed resources, nutrient recycling (N, P), coproduct use, etc.), in order to design agroecological and regional value chains. Increasing protein autonomy will rely on improving of animal and plant production coupling and proximity. Deploying local agroecological value chains – combining economic and environmental performance – requires a redesign of production systems as a whole, rather than testing isolated solutions and adding them. This therefore calls for the ability to conduct long-term trials under real-world conditions, with the involvement of stakeholders to facilitate their dissemination and adoption.

**Recent scientific advances:** Long-term testing of agricultural frameworks that integrate arable farming, grassland, livestock farming and semi-natural areas with the aim to adapt to local environment and to promote inter-species and inter-habitat complementarity, enabling environmental and economic benefits.

**Needs for further research:** Support and structure an interdisciplinary scientific community for tackling research issues on animal and plant production coupling especially in monogastric species that heavily depend on imported feed resources (which pairs of plants and animals should be considered to set up resilient and competitive mixed systems? how to breed for more compatibility? how to empower alternative protein-rich plant production for animals?); managing manure for both organic fertilization and pollutant flows; generalise and upscale the outputs of living labs experiments.

## 4) Conserve, characterise and deploy genetic resources and support breeding to enhance resilience and competitiveness

The agroecological transition strongly relies on crop and livestock diversification, notably by making use of intra- and interspecific diversity; identifying the best-suited animals for mixed-farming system will help to strengthen their resilience and their ability to adapt to climate change. The genetic resources conserved in INRAE-managed resources centres (over 9,000 individuals for animal species) serve as a solid basis for fuelling genetic studies but the value of most ancient genetic resources is poorly assessed for agroecological practices and adaptation to climate change. For agroecology and One Health, new traits with not yet economic values will be at stake, that need anticipation.

**Recent scientific advances:** Large-scale sequencing of animal genetic resources with a pan-genomic approaches enabling a better knowledge of genetic variations to be further associated with important phenotypic traits; study of animal microbiomes as genetic resources to characterise and preserve; contribution to the diversification of breeding goals from production to production and functional traits.

**Needs for further research:** Support existing facilities and develop complementary tools to preserve animal genetic resources, assess their phenotypic potential (in vivo, ex-vivo and in-vitro experimentation capacities) and operationalize their use; connect with FAO to empower genetic diversity knowledge of mainstream and local resources; state-of-the-art genomics, high-throughput phenotyping, AI and digital tools to functionally characterise the animal genetic diversity and integrate new dimensions such as links and pairing with microbiomes; development of statistical genetic models able to integrate information from small and large populations raised in a diversity of environments to provide solutions tailored to various climatic and agroecological context; methods to jointly assess the genetic trade off and the economic value to be attributed to new traits relating to environment, welfare, etc.

## 5) Connect animal production to the quality of animal-source foods

The quality of animal products remains a major scientific, economic and societal challenge, reinforced by the evolution of the animal production systems. Indeed, animal-source products provide a wide range of high-quality food. By providing healthy, safe and environmentally friendly food, the sustainable livestock systems to come should tightly connect the agroecological transition with One Health, as agricultural and food systems as a whole. A forward-looking dialogue is expected to align the sustainability goals of future livestock systems with healthy diets at European level.

**Recent scientific advances:** Data from studies to understand, control and predict the development of animal product quality, integrating biological, technological, nutritional, sensory and health dimensions, whilst taking into account farming practices and their evolution.

**Needs for further research:** Analysis of target tissue dynamics at different stages of the animals' lives to control the quality of their products; quality assessment of animal products in different environments and under different practices; characterisation of the exposome and its consequences; understanding the interactions, synergies and trade-offs between these different dimensions of quality in order to identify levers for simultaneously improving the performance of livestock systems, product quality and their societal acceptability.