

**atf**

**animal  
task  
force**

A European Public-Private Platform

# **A strategic research and innovation agenda for a sustainable livestock sector in Europe**

Suggested priorities for research  
for Horizon2020 2018-2020 Work Programme  
to enhance innovation and sustainability in the livestock production sector  
of Europe's food supply chains

**Second White Paper of the Animal Task Force**  
Short Version





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This brochure is a short version of the 2<sup>nd</sup> White Paper of the Animal Task Force, a strategic research and innovation agenda for a sustainable livestock sector in Europe



## Full documents available on the ATF website:

2<sup>nd</sup> White Paper of the Animal Task Force

[www.animaltaskforce.eu/Portals/0/2nd%20White%20Paper/ATF-2nd%20whitepaper\\_final.pdf](http://www.animaltaskforce.eu/Portals/0/2nd%20White%20Paper/ATF-2nd%20whitepaper_final.pdf)

Appendix 2: Fit with past and on-going projects (EU funded)

[www.animaltaskforce.eu/Portals/0/2nd%20White%20Paper/ATF-2nd%20whitepaper-Appendix02.pdf](http://www.animaltaskforce.eu/Portals/0/2nd%20White%20Paper/ATF-2nd%20whitepaper-Appendix02.pdf)

# General introduction

## Future challenges for animal production in Europe

The livestock<sup>1</sup> sector contributes substantially to the European economy (€130 billion annually, 48% of the total agricultural activity) and creates employment for almost 30 million people. Animal products are essential for a healthy and balanced diet. The European demand for animal products might decrease slightly in the coming decades but the worldwide demand for animal products is predicted to double over the next decades due to population growth and increasing prosperity. This creates a huge responsibility for the European livestock sector and food chains in terms of export opportunities of animal products for a growing middle class in areas/countries with high population growth that often are not able to produce the necessary livestock products for their own growing population. But also in terms of export opportunities of scientific knowledge and know-how enabling these countries to increase their local production capacities. European standards are extremely high compared to those from other parts of the world in terms of animal welfare, safety, healthiness, environment, etc. The livestock sector is contributing substantially to the European economy in terms of national income, employment and contribution to the trade balance.

Livestock are present in almost all regions in Europe in a wide range of different production systems and inextricably linked to rural vitality. The livestock sector in Europe has to overcome

cyclical crisis, and livestock farmers' income remains a tremendous problem. Any reduction of livestock farming would also affect the vitality of many European territories and the supply of high quality and safe European animal products. Food production is a major part of the bio-economic system. Scarcity of resources has increased with the extra food that needs to be produced and rising demand for bio-energy and bio-based products in the context of climate change (4<sup>th</sup> Foresight of the Standing Committee for Agricultural Research). This will require increased resource use efficiency to mitigate the environmental footprint of agriculture.

The past has highlighted the drawbacks of continuous growth of the animal sector despite huge efforts and progresses have been achieved by farmers to tackle these drawbacks. These include challenges to the environment to climate change, animal and human health. There are also challenges related to the welfare of animals, to the human health issues linked to the over-consumption of animal products, and more recently the competition between human and animal for feed resources. Environmental policies require to reduce the environmental footprint of agriculture, particularly by reducing greenhouse gases, nitrate, ammonia and phosphorus emissions, loss of carbon from agricultural soils and the use of antibiotics.

(addressed by EATIP), fisheries, game, companion animals, bees for honey and other insects produced for food are not considered.

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<sup>1</sup> In this document, the term « livestock » includes herbivores (ruminants, horses, rabbits) and monogastrics (pigs, poultry). Aquaculture

The livestock sector can positively contribute to reduce the effect of food systems on the environment and on climate change by contributing to adaptation and mitigation strategies and to the 4/1000 initiative. On the reverse, the climate change will challenge the adaptive capacity of the animals and feed production systems to cope with the warming increases and record temperatures, and increase the need to study trade-offs between robustness and efficiency. International cooperation on these challenges is key as Europe can benefit from animal genetic resources that are present in tropical countries.

Antimicrobial resistance is a major threat to public health. In 2015, the World Health Organisation adopted a global plan to combat resistance to antibiotics in the conceptual framework "One World, One Health". European farmers have to meet tight restrictions on the use of chemical control methods. Furthermore, there is currently no prophylaxis and/or therapy for some diseases like Paratuberculosis in cattle, Avian Influenza and African Swine Fever in pigs. Integrated management (breeding, feeding, prevention, vaccination, organisation of actors) of animal health and welfare has to be developed based on exploitation of resistance mechanisms, optimization of gut health and innovative adaptation of livestock production systems and practices. This should include biosecurity,

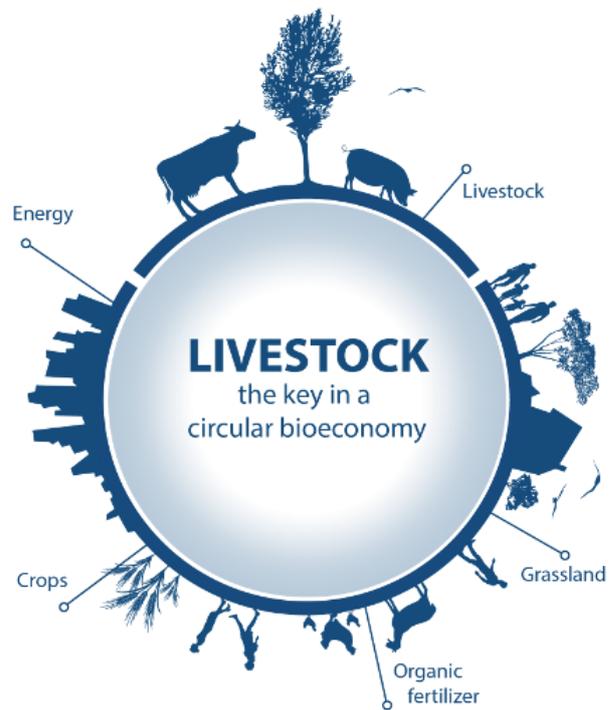
(better) vaccines and optimal use thereof, diagnostic tools, hygiene guidelines, management, breeding and reproduction in combination with smart farming tools, sensors and big data analyses.

The demand and consumption patterns for animal products are evolving. The consumption of meat and dairy products per capita is decreasing in most European countries, with differences according countries and species. This consumption may decrease even more as a consequence of the development of radically new technologies as affordable alternatives and new consumption patterns. Beyond safety issues that remain the top priority, the market will also need healthier products and products better suiting the requirements of specific populations. In addition, consumers' engagement and perceptions of food are changing and diversifying. Animal-based food contributes to healthy diets and wellbeing. Beyond the nutritional and organoleptic quality ('intrinsic value of food'), other criteria such as environmental footprint, animal welfare or the production of public goods (open landscape, image of naturalness...) are determining the consumption choices ('extrinsic value of food'). Besides a main stream, research should consider an increasing segmentation of the market of animal products in the context of agri-food chains.

## Livestock's role in realising a sustainable circular bio-economy for Europe

Taking active stake in Sustainable Development Goals (SDGs), the European animal production sector has a major opportunity to contribute to more sustainable food and nutrition systems. European agriculture must be competitive on the global stage. It should also lead the way in environmental stewardship and ensure socially responsible European animal productions in a changing global world. In a global circular bio-economy, livestock have many valuable roles:

- ▶ to provide sufficient protein-rich, safe and healthy food for humans with high nutritional and organoleptic values, responding to a diversifying demand, produced in a way that does not challenge human health, safety, and thus avoiding the double burden of over- and under-nutrition;
- ▶ to regulate the ecological cycles and close the nutrient loop by recycling, as much as possible, biomass from humanly inedible resources, or otherwise not suited for human consumption, derived both from marginal lands or in mountainous areas and that are not able to produce plant products for human consumption and also using manure as a bio-resource;
- ▶ to develop animal friendly rearing and production systems that meet the physiological and behavioural needs of farm animals;
- ▶ to contribute to a more efficient agriculture by valorising food-chain by-products as animal feed and nutraceutical and using new protein sources for efficient and robust animals adapted to such new European feed sources;
- ▶ to integrate new farming systems with automatic surveillance and registration of production, health and welfare of the individual animals for better management



thereof, for better genetic improvement, for reduced emissions and for proper handling of manure;

- ▶ to improve soil fertility (structural stability, organic matter content and biological fertility), by the use of grassland and proper spreading of manure;
- ▶ to provide raw material for renewable energy and valuable by-products;
- ▶ to provide ecosystem services linked to the vitality of diverse territories, employment in rural area, landscape and biodiversity preservation and cultural heritage.

Livestock systems would need to be discussed with the society and adapted to the diversity of regional and economic contexts. This diversity can be considered a reflection of the agricultural heritage and as such represents an asset to be protected. The society should be aware of the social and ethical value of the people working with and in these systems and the value of the individual animals living in these systems.

## The importance of supporting innovation, sustainability and competitiveness in Europe's livestock sector

Research and innovation have contributed substantially to make Europe's livestock sector as competitive, balanced and efficient as it is today. Continued support for research and innovation in the livestock sector is needed to meet the new challenges and to support the adaptation of these innovations in the corresponding farming systems. These challenges include the supply of nutritious, safe and healthy food, reducing environmental impact, making better use of resources, respecting animal integrity and contributing to human and animal health and welfare, meeting needs of consumers and contributing to a viable bio-economy in ways that are appreciated by the society.

This requires coordinated and integrated interdisciplinary research and effective, proactive translation into practice and policy making. We recommend strengthening joint activities between different Work Programmes such as 'Societal Challenge 2 - Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy', 'Societal Challenge 5 - Climate action, environment, resource efficiency and raw materials', 'Excellent Science', 'Leadership in enabling and industrial technologies' (LEIT). This will help avoid gaps and overlaps, ensure synergies and facilitate the wider agendas for skills, innovation and research infrastructures.

## The Animal Task Force's Strategic Research and Innovation Agenda, Dec. 2016

The Animal Task Force presented a White Paper with key areas and priority-topics for European research support to the livestock sector in April 2013 and an addendum in November 2014. This Second ATF White Paper (2016) is an updated view on the next steps in research developed for the Horizon2020 2018-2020 Work Programme with new key areas and priority-topics, positioning the livestock sector as a key player in a European sustainable circular bio-economy. It was developed by the ATF management board after a peer analysis of research gaps from past and on-going projects (FP6, FP7, H2020), and expanded through a consultation among ATF members.

This update was also inspired by the 4th SCAR Foresight Exercise, the strategic approach to EU agricultural Research & innovation (European Commission), the FACCE-JPI and Healthy Diet for Healthy Life-JPI, Global Agenda for Sustainable Livestock, Global Research Alliance on agricultural greenhouse gases, FAO, SCAR working group on Sustainable Animal Production, ERA-NET ANIWAH and through exchange of views with EC DGs (DG Agri, DG RTD, DG Envi, DG Clima, DG Connect, DG Sante, DG Devco...), European Parliament members and a large range of European and member states stakeholders from industry, farmers organisations, interbranch organisations, NGOs, think tanks (Farm Europe), etc. Special attention was paid to connecting with other ETPs (Plant for Future, TP Organics, Food for Life) and European Platforms (Euromontana) for cross-fertilisation for the elaboration of the Strategic Research Agendas.

The Animal Task Force promotes interdisciplinary research and innovation bringing together research groups with complementary expertise (feeding strategies, animal breeding and genetics, nutrition, physiology and health, (ICT) technology, food evaluation, modelling, economics, sociology, multi-criteria evaluation). Research and innovation actions should involve actors of the agri-food chain (farmers, upstream industry, machinery and robotics, dairy and meat industry) and of the territories. They should aim to improve all systems of production, including the sustainability of European intensive systems, low inputs systems, organic and agro-ecological systems. Several areas of research are particularly suited for international cooperation, especially in tropical environment.

The Animal Task Force also encourages future development of livestock production systems from a perspective of ecosystem services together with holistic agriculture approaches. They more closely link livestock and plant sciences to make better use and protect the properties of agro-ecosystems and to maximise the use of biomasses of plant and animal origins through recycling and cascading approaches. These holistic agriculture approaches also need to encompass the agro-ecological domain and would stretch to consumers' global health by integrating from the ecosystem of a healthy soil, plants and animals in good physiological and sanitary conditions and healthy humans.

## Stakeholder's supports

*The table lists the organisations, European and member states stakeholders from the industry, farmers' organisations, interbranch organisations, NGOs, think tanks consulted that support the 2<sup>nd</sup> White Paper of the Animal Task Force.*

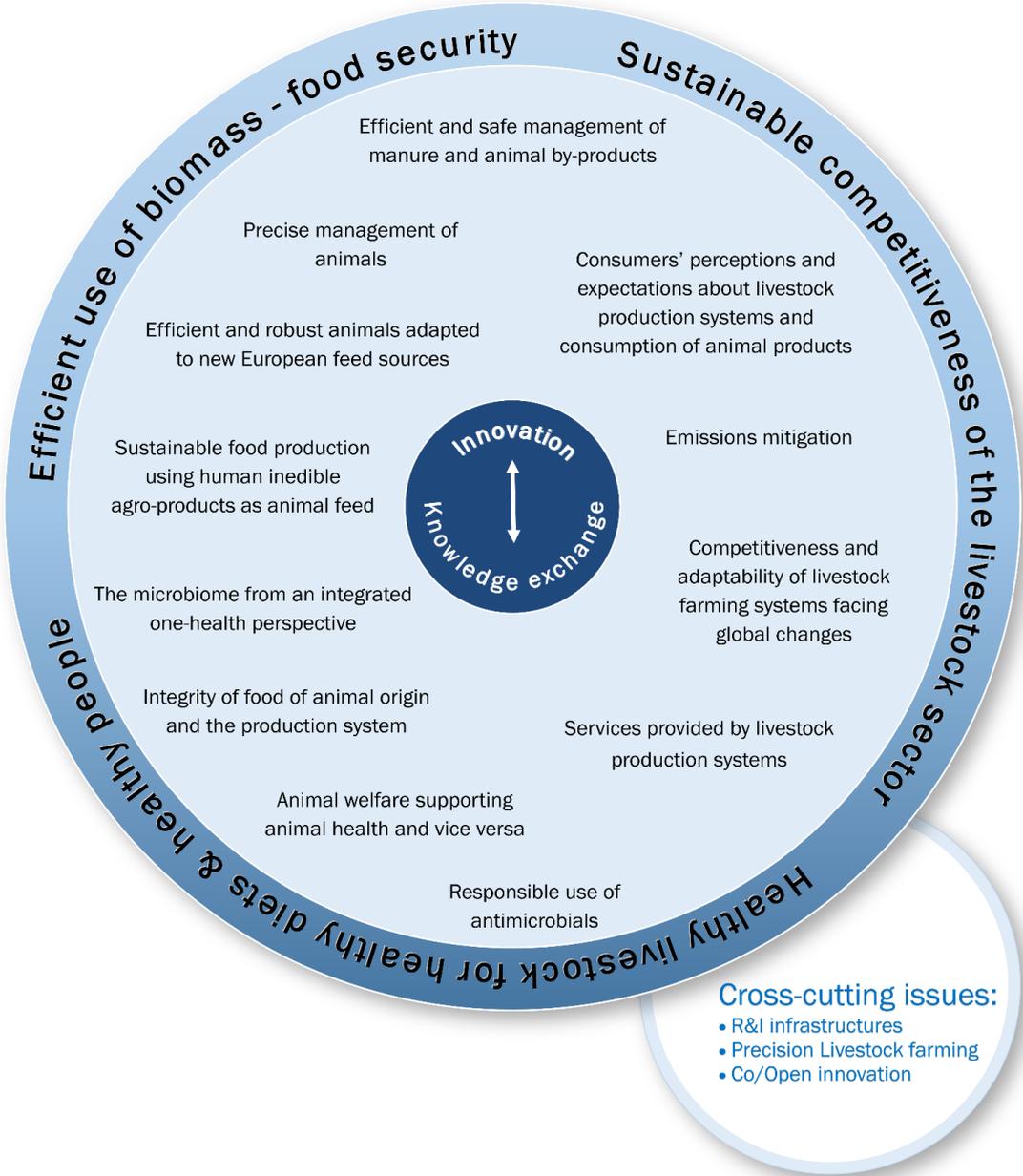
Organisation name and Short name	Country	Type	
		Industry	Farmers' organisation
Agriculture & Horticulture Development Board (AHDB) (levy body)	UK	X	X
Agrifirm	NL	X	
Alltech	IE	X	
Association of Swiss Cattle Breeders (ASR)	CH		X
Association of the Swiss pig breeders (Suisseporcs)	CH		X
CEJA, European Council of Young Farmers	EU		X
CEMA, European Agricultural Machinery Industry	EU	X	
CNIEL interbranch organisation	FR	X	X
Confédération Nationale de l'Élevage France (CNE)	FR		X
DairyNL	NL	X	
Danish Agriculture and Food Council	DK	X	X
European Feed Association (EUFETEC)	EU	X	
European Feed Manufacturers Federation (FEFAC)	EU	X	
European Specialty feed ingredients (FEFANA)	EU	X	
ELANCO	Int.	X	
Glanbia	IE	X	
Interbev interbranch organisation	FR	X	X
McDonald's France	FR	X	
Swiss Milk (SMP)	CH	X	
Olmix group	FR	X	
PROVIANDE (The Swiss Meat Industry Association)	CH	X	
UFA AG (Union of agricultural cooperatives)	CH		X

Topics related to organic and low-input farming in sections 2.3. and 2.4 are supported by TP Organics. Topic 3.4 "Integrity of food of animal origin and the production system is supported by Food For Life ETP.

# Key areas for research and innovation in the animal production sector that merit support under Horizon2020 2018-2020 Work Programme

These suggestions are the shared view ATF members.

*The figure illustrates the main topics and sub-topics that we suggest as prime areas for further research. All topics and sub-topics are described in this 2<sup>nd</sup> White Paper of the Animal task Force.*



# 1. Efficient use of biomass & Food security



Livestock are able to recycle biomass that is not directly usable for human food and grains that are not suitable for grain markets to produce food of high nutritional quality. They have an important influence on the N, P and C cycles, which in turn contribute to the production of biomass. **Manure** should be considered as a resource rather than a waste. It contributes to soil fertility, which in turn is positive for the sustainability of plant production. Apart from their contribution to the **regulation of ecological cycles**, livestock can also contribute to a sustainable circular European Bioeconomy in two ways:

- ▶ deriving value from grazed pasture and new resources (by-products, crops residues or wastes from agro industry or bio-refineries) by converting them into animal products, which may require the development of new technologies to ensure the safety of these by-products for feed use;
- ▶ bio-refinery of animal by-products as manure and wastes from slaughterhouses, hatcheries and dairy industries.

Affirmation of the role of livestock in a European sustainable Bioeconomy will require:

- ▶ better quantification of the **contribution of livestock production** to ecosystems function, to protein security and quality and supplying demand for healthy food;
- ▶ increasing the **efficiency of feed chains** with a cascading approach;
- ▶ increasing the **efficiency and robustness of animal and herds** and closing the loops, mitigating GHG emissions and improving manure management.

## 1.1. Sustainable food production using human inedible agro-products as animal feed

### Challenges

European livestock production is strongly dependent on protein rich feed resources that are imported and/or that can be used for human consumption directly. In the long run, this is not sustainable. In the face of growing food security uncertainty, there is a need for new initiatives in Europe. Thus, the **development of alternative protein supply strategies** that minimise reliance on imports and implementing a circular economy for nutrients and biomass is of key importance.

On the other hand, livestock production is absolutely necessary in the bio-economy to ensure a maximum use of biomass produced in a circular economy with an **optimal utilisation of biomass components across industries**. The exploitation of various raw biomaterial resources can be the driving force to develop new feeds. This leads to an important question: what geographical scale is needed to improve efficiency and acceptability? New opportunities can be found when **livestock and crop production are interconnected**, together with biotechnical and social sciences.

### Suggested scopes of research/topics

- ▶ **Improvement of biomass utilisation and development of alternative feeds not competing with human food**
  - Research and development on novel feed materials
  - Better utilisation of existing local protein
  - Novel/improved processes enabling a more efficient use of raw materials
- ▶ **Evaluation of the novel options and technologies for feed production, evaluation and optimised utilisation**
  - Assessment of the feeds and feed chains
  - Assessment of social acceptability of novel options for feed production and utilisation
  - Study drivers for change
- ▶ **New feeding strategies to reduce feed versus food competition**
  - Development of feeding strategies
  - Designing integrated crop-livestock farming systems
  - Genetic adaptation of animal to new feeding strategies

### Expected impact

- ▶ New unique ways of efficient resource-use at system level that reduce wastes in the feed and food chain;
  - ▶ Delivery of the best strategies to develop economically viable and resilient systems with alternative protein;
  - ▶ Improved protein recovery from various by-products and wastes;
  - ▶ Reduced protein imports into Europe, reduced competition between feed and food production;
    - ▶ Development of SMEs for the production of new proteins;
    - ▶ Optimal and efficient use of land;
    - ▶ Key enabling technological developments will make Europe frontrunner in the re-use of by-products and protein-rich resources for feed.

## 1.2. Efficient and robust animals adapted to new European feed sources

### Challenges

Improving the efficiency of animals will allow to reduce resource use and will also contribute to reduce environmental impact. The FCR (feed conversion ratio) has already significantly decreased in the past years through successful breeding and increasing energy concentration of the diets. But today, FCR needs to go a step further when livestock have to be fed rations with lower or more variable energy (and protein) concentration.

**Animal health and resilience** (incl. fertility) also play a crucial role in resource efficiency. This also renews the challenge for **animal breeding**, in order to identify **new and reliable indicators of resource efficiency, appropriate genotypes, phenotypes and indicator traits**, some **potential trade-offs** between FCR and other phenotypes that may alter long-term selection strategies to improve lifetime efficiency. Attention should be given to **adaptation of animals to new environmental conditions** (such as new feed sources, varying climate conditions).

### Suggested scopes of research/topics

#### ▶ Definition of the new sustainable breeding goals

- Improving simultaneously animal efficiency and robustness in the context of expected changes in animal diets

#### ▶ Development of appropriate phenotypes and indicators for selection on efficiency and robustness

- Quantification of the optimal balance between efficiency and robustness
- Exploration of combining new molecular phenotypes with new and traditional external phenotypes
- Exploiting epigenetic mechanisms to generate genotypes/phenotypes that are better adapted to environmental conditions
- Conservation, characterisation and use of genetic resources from local breeds and breeds in developing countries as a source of genetic variability, biodiversity and intrinsic value

#### ▶ Genome editing: a new issue

- Identification of relevant targets and opportunities for Genome Editing (role, efficiency, added value and social acceptability)
- Biological understanding of genes underlying complex traits

### Expected impact

- ▶ More efficient and robust animals contributing to resource use efficiency (reduced resource use and loss);
  - ▶ Lesser quantities of medicines (antibiotics, anthelmintics);
  - ▶ More efficient animal production and improved animal welfare;
  - ▶ Decreased risk of antibiotic-resistance in the environment and in the human population;
  - ▶ Increased animal resilience to climate change.

## 1.3. Precise management of animals

### Challenges

Precision Livestock Farming (PLF) and related technologies have huge potential to achieve a more efficient use of resources and a “smart” livestock farming. **Thanks to new sensor technologies integrated in monitoring systems, farmers and service providers will be able to continuously and automatically collect and process the information needed to manage production efficiency and product quality, emissions to the environment, use of medicine and animal welfare.** They will also assure citizens that livestock production is safe, humane and environmentally sustainable, while reducing farm labour requirements.

For the **breeding sector**, it is crucial to **renew predictive and systems biology approaches** and generate new knowledge for more competitive breeding and smarter farming. From the **animal perspective**, PLF technologies potentially provide solutions to the current lack of standardised data to objectively determine **animal welfare and health status** in the production chain. From a **social perspective**, precision livestock farming will change the farmer’s work. In addition, several hurdles in **sharing of (open) data** have to be overcome. From a **technical perspective**, the development of PLF requires the development of **innovative technologies** such as sensor technology, bio-sensors, robotics, information and communication technology, standardisation and user-centric design methods.

### Suggested scopes of research/topics

#### ▶ Innovative sensors and intelligent models for monitoring resource use efficiency, animal health, animal welfare and livestock performance

- Monitoring and management of nutrient use (in)efficiencies
- Improved management systems for feed distribution at farm level
- Development of innovative sensors and intelligent models for animal health management
- Surveillance and risk analysis by authorities
- Identification and implementation of animal-based welfare indicators, using new technologies

#### ▶ Innovation in PLF for pastoralism and more generally for nature-based systems

- Developing the monitoring of animals reared outdoors using satellite information, drones, energy efficiency, precision monitoring

#### ▶ Evaluation of social consequences of the implementation of PLF

- Consequences on farming management, work
- Societal perception of livestock production with PLF technologies.

#### Expected impact

- ▶ More efficient management of farmers and service providers;
- ▶ Reduction of wastes;
- ▶ Mitigation of emissions;
- ▶ Early detection of irregularities and improvement of animal welfare and health;
- ▶ Better traceability of the food;
- ▶ Strong social impact: farmers will be supported in giving care to individual animals that are part of groups;
- ▶ Further development of precision livestock farming sector in Europe.

## 1.4. Efficient and safe management of manure and animal by-products

### Challenges

Animal manure is an important source of N and P for crop production and organic matter contributing to soil fertility. In intensive livestock production systems, however, it is often seen as a residual burden rather than a valuable resource and there are significant losses. For many soils, the main fertility problem is deficiency of P and other micronutrients, while in other soils there be excessive P accumulation. **Effective manure management** can improve resource efficiency by using manure as a valuable resource. In particular, the **re-use of N and P offers tremendous opportunities for closing the nutrient cycles**, increase resource efficiency, restrict pollution and eutrophication of ground waters and soils, and reduce the EU's dependency on phosphorus imports.

Manure is also a unique source of carbon, humic substance and microorganisms for **soils**. The role of manure in the biological life of the soil and on soil fertility, however, is yet largely unknown. The increasing biodiversity in the soils should confer resilience and higher fertility. In addition, **integrated manure management** offers new solutions for on-farm or biogas plant energy production. On the other hand, **manure can contain organic pollutants**, residues of antibiotics, anthelmintics, biocides and others biological agents with potential risk for the environment and human health.

### Suggested scopes of research/topics

#### ▶ Evaluation of the effect of manure and organic wastes from animal industry on soil fertility

- Understanding the role of manure on the biological life of the soil

#### ▶ Evaluation of local systems organisation to improve the efficiency of manure utilisation

- Adaptation of nutrient flows on farms and on regional levels, socio-economic studies
- Developing business models

#### ▶ Evaluation of the risks associated to the use of manure and organic wastes from animal industry

- Analysis of the transfer and discharge of pathogens, antibiotics, anthelmintics, hormones from manure treatment plants
- Reduce the production and distribution of medicine residuals and endotoxins

#### ▶ Innovative manure refinery technologies

- Developing fertilizers and non-agricultural markets from manure

#### ▶ Non-food application of animal products components

- Innovations from biological and physicochemical properties of animal products

### Expected impact

- ▶ new unique ways of efficient resource-use at system level that reduce wastes;
- ▶ improvements in the re-use of nutrients in manure, less negative environmental impact, mitigation of emissions;
- ▶ improved fertilizer value of manures;
- ▶ less use of mineral fertilizers;
- ▶ preservation of natural P resource;
- ▶ improved soil fertility;
- ▶ cascading utilisation of manure, development of high value-added products from manure, development of bio-based industry valorising animal by-products;
- ▶ innovative non-food utilisation of some components of products of animal origin.

## 2. Sustainable competitiveness of the livestock sector



**Livestock farming systems** generate valuable and desirable products, essential for a healthy balanced human diet and they also support the development of rural communities. They adjust continuously to competitiveness, food safety and animal welfare standards, climate change and environmental issues. Their farming conditions, challenges and constraints are **contrasted** in Europe due to geographical, ecological and sociological diversities.

Livestock production is being scrutinised by European society, in particular “industrial” livestock production systems, assumed to have an adverse effect on animal welfare and on the environment. **Ethical and nutritional considerations** are developed against animal production and consumption. In many areas, livestock farming is recognised for its positive contributions to the society, but there farmers cannot compete with more intensive systems and have to seek alternative ways to maintain an **acceptable standard of living**. Some rural and peri-urban areas are now benefitting from a new role of agriculture and agri-food sector in local development.

Further research is needed to **understand both the farmers and societal expectations** to better identify opportunities, provide the most appropriate responses and feed into the continuous discussion between the livestock sector and society, but also provide responses to the **lack of attraction that livestock farming** holds for the next generation of farmers and farm workers.

## 2.1. Consumers' perceptions and expectations about livestock production systems and consumption of animal products

### Challenges

Animal proteins are essential for a balanced diet to maintain good health for the general population. Consumers have generally a rather good opinion of farmers, but some of express concerns about the consumption of food of animal origin due to welfare issues and food safety reasons. **Social acceptance** of livestock production and livestock products is crucial and research is required on the evolution of acceptance and consumption of livestock products, with time, in different European regions and with regard to the general economic situations. It is essential to **create a constructive dialogue** and build consensus to secure a safe and high-quality European livestock production for European consumers and exports, based on improved social acceptability, environmental sustainability and economic competitiveness.

### Suggested scopes of research/topics

- ▶ **Understanding of the controversies related to livestock production systems and livestock products**
  - Evaluation of consumers' preferences with special attention to animal product consumption
  - Evaluation of the role of various actors
  - Analyses of factors determining consumers' willingness to pay a premium for a differentiated product
- ▶ **Improvement of the transparency of animal production chains and of the confidence of consumers**
  - Evaluation and use patterns of new IT tools
  - Evaluation and use patterns of new and sustainable packaging at low environmental impact
  - Evaluation of the feasibility of co-designing innovative/alternative livestock production systems

### Expected impact

- ▶ Improved future strategies of livestock production, underpinned by a better understanding of controversies;
  - ▶ Better understanding of consumer awareness, knowledge and behaviour about livestock and consumption of animal based products;
    - ▶ Increased societal acceptance of animal agriculture by the society;
    - ▶ Improved strategies for communicating the role of livestock in food systems;
    - ▶ Re-established contacts between consumers and livestock producers;
    - ▶ Development of a better shared vision among stakeholders on the future of livestock;
    - ▶ Definition of a development strategy;
    - ▶ Better transparency of production processes for the general public.

## 2.2. Emissions mitigation

### Challenges

The livestock sector contributes significantly to the emission of greenhouse gases (GHG), representing 14.5% of total GHG emissions. Ruminants are the largest contributors, accounting for 60% of total livestock emissions, in particular via enteric methane, whose mitigation potential is important (FAO, 2013). There is a strong requirement to mitigate these emissions and to develop a low-carbon livestock agriculture. **Mitigation options** can be found in the production of feed, enteric methane production, manure production, energy consumption and carbon sequestration in soils. Apart from GHG, air pollutants include ammonia and other nitrogen compounds (NOX), dust particles, sediments and odours. Water pollutants include Nitrate, P and pesticides. Soil pollutants include trace elements, pesticides and antibiotics residues. Research is needed to reduce GHG emission without negative effects on other emissions (risk of pollution transfer) or on livestock productivity.

**Research on integrating adaptation and mitigation** has started in several recent research projects. Progress is still needed to mitigate GHG emissions, however, and this remains a major challenge for the livestock sector.

### Suggested scopes of research/topics

#### ▶ **Method development of measurement of emissions**

- More precise and holistic measures and modelling of emissions under field conditions
- Improvement of life cycle analysis (LCA) methods for a more holistic evaluation of livestock performances

#### ▶ **Avenues to further reduce emissions using win-win strategies**

- Development of holistic approaches to analyse and decrease the environmental impact of livestock farming
- Studying food production systems, incl. both production and consumption and the role of livestock in the food chain

#### ▶ **Increasing soil organic matter and carbon storage.**

- Techniques including utilisation of grassland and return of various forms of manure to the soil with the objective of designing economically and environmentally sound models to improve soil organic matter carbon

storage, biological fertility, biodiversity, plant disease occurrence, quality of crops and financial margins resilience of livestock farming systems

### Expected impact

- ▶ Reduced GHG emissions and other emissions to air and water;
- ▶ Implementation of Paris Agreement;
- ▶ Reduced emissions having potential negative effects on water and air quality;
- ▶ Increased soil C sequestration and improved soil fertility;
- ▶ Development of innovative and more holistic tools to evaluate emissions on farms;
- ▶ Develop a more holistic view of the impacts of animal production on the environment;
- ▶ Europe can take the lead by being a frontrunner in creating new solutions, and knowledge sharing around climate smart agriculture.

## 2.3. Competitiveness and adaptability of livestock farming systems facing global changes

### Challenges

In **intensive systems**, the mainstream commodity system favours work productivity as an essential criterion for competitiveness; the EU livestock sector needs to be productive and competitive to take advantage of the high EU production standards for exports. Some chain operators have chosen a different path of development, with a differentiation founded on the quality or origin of the product, supported by a list of specifications. These **alternative systems** are of particular importance for less-favoured areas that are not able to compete with more favourable regions on a standard market.

In the context of increased price volatility, occurrence of extreme weather events due to climate warming and increased risk of outbreaks of epizootic diseases, the capacity of the systems to be maintained over time when changes occur becomes important. **Trade-offs between efficiency and resilience** may appear. It is now very difficult to imagine the best ways of (re)designing the production systems facing these challenges. **In addition, livestock production as an occupation** suffers from low attractiveness. The development of innovative **livestock farming systems that fit the farmer's will and skills** would stimulate young farmer entrants, thus contributing to the development of less favoured regions and reducing the average age of farmers.

### Suggested scopes of research/topics

The topics related to organic and low-input farming in this section are supported by TP Organics.

#### ► Evaluation of economic competitiveness of livestock farming systems across Europe

- Evaluation of strengths, weaknesses and evolution processes of livestock systems under market drivers

#### ► Analysis of the adaptive capacities of livestock production systems

- Evaluation of adaptive capacities of livestock systems and potential trade-off with efficiency
- Analysing the most adapted agro-livestock combinations in a given environment
- Improvement of the contribution of livestock farming to the empowerment of rural areas

#### ► Using animal adaptive capacities to enhance the adaptive capacity of systems

- Identification of the mechanisms driving animal efficiency and adaptive capacities

- Alternative production systems with improved resilience

#### ► Designing livestock farming systems consistent with farmer's will and skills

- Development of labour efficiency indicators and frameworks to stimulate changes in management
- Analysis of levers and lock in for settlement and attractiveness

### Expected impact

- Increased capacity of the diverse livestock systems to address global changes;

- Adaptation of animal genetics to the various contexts;

- Perspective for local food development; Segmentation of food to better fit the diverse consumers' demands;

- Characterisation of benefits and risk of the co-existence of livestock systems and a diversity of food systems.

## 2.4. Services provided by livestock production systems

### Challenges

Livestock systems provide **multiple benefits** such as protein-rich food for humans from inedible resources, contribution to food security and employment, provision of ecosystem services such as landscape heritage and biodiversity conservation. On the other hand, livestock systems also exert negative impacts such as environmental pollution, competition between food and feed, land degradation, emergence of zoonosis, animal welfare issues, and ethical issues related to changes in socio-cultural values.

We need to develop a comprehensive framework, including metrics, robust analytical tools and methods, to assess the **sustainability of EU livestock systems in various territorial contexts** while taking into account possible trade-offs and synergies among the supply of ecosystem services, social services, competitiveness and resilience of the livestock production systems. This will require a systems approach including inter- and transdisciplinary research and socioeconomic research.

### Suggested scopes of research/topics

The topics related to organic and low-input farming in this section are supported by TP Organics.

#### ▶ Developing metrics for measuring ecosystem and social services delivered by livestock systems

- Development of new sustainability metrics
- Provision of a framework for assessing cost-benefit portfolios of livestock systems at levels from farm to territory and EU region

#### ▶ Understanding of trade-offs and synergies within and between benefits and costs, paying special attention to the social aspects

- Analysis of integrated livestock-arable systems at farm/regional scale
- Analysis of benefits and services provided by urban and peri-urban farming systems
- Analysis of the conditions for better connection between animal production value chains to territories
- Analysis of the potential role of horses for leisure, draught and landscape maintenance or sport

#### ▶ Enhancing the establishment of a highly sustainable livestock sector by multi-actor approaches

- Development of exploratory scenarios based on participatory approaches

### Expected impact

- ▶ New sustainability metrics describing the ecosystem, economics and social benefits provided by livestock; Evaluation of hidden benefits of animal agriculture;
- ▶ Enhanced delivery of public goods by livestock farming systems in Europe; Targeted policy instruments to promote the production of public goods;
- ▶ Increased societal acceptance of animal agriculture thanks to the improvement of farming practices; Better understanding of farming practices by the society;
- ▶ Development of a more holistic view of animal production and benefits to the society;
- ▶ Transparent and comprehensive accounting for sustainability of the entire EU livestock sector;
- ▶ Better self-image of farmers;
- ▶ Improved livestock sector efficiency and profitability at four strategic levels: farm, territory, EU, and supply chain.

### 3. Healthy livestock for healthy diets and healthy people



In a context of continuous adaptation of farming systems towards sustainability, globalisation of societies, economies and societal expectations, animal health is of utmost importance for human health, animal welfare, resource efficiency, product quality, efficiency of production and to safeguard the trade in animals and animal products. Inappropriate uses of antimicrobials and other medicines have compromised their effectiveness and generated an increased emission of residues to the environment. The on-going emergence of antimicrobial-resistance is considered the single largest threat to both human and animal health. It affects consumers' confidence and leads to restrictive measures in public policies.

Health issues should be considered at a global dimension as new diseases and pests arise regularly. We support the 'One Health' approach to realise a healthy livestock sector allied to feed and food safety. We promote **integrated strategies** for disease prevention or control, and multi-disciplinary and multi-stakeholder research with a systems approach to support adaptation of agricultural production systems to better fit human, animal and environmental health. Research and innovation could include **animal health and welfare, public health and the total food chain**. The actions under this heading adhere to the EU animal health strategy "prevention is better than cure". Besides innovations, not only innovation is required but also optimal implementation of existing and innovative tools.

## 3.1. Responsible use of Antimicrobials

### Challenges

The steady increase in **antimicrobial resistance** (antibiotics) is a major threat in terms of public health and is a pressing economic issue. Very few antibiotics have been developed in recent decades or are expected in the near future. In livestock farming, there is a need to reduce the use of antibiotics, biocides and synthetic pesticides and optimise dosages and administration for therapy, control and prevention without compromising public and animal health and welfare to reduce the risk of resistance, especially for critical antibiotics (essential to treat certain human bacterial diseases).

Besides antibiotics, resistance to **parasitic drugs** (like anthelmintics and treatments against livestock pests and parasites) is also an important issue for animal health but also public health and health of ecosystems (e.g. Ivermectin). An organised interdisciplinary research is essential.

### Suggested scopes of research/topics

The actions adhere to the EU Joint Programming Initiative on Antimicrobial Resistance (JPI AMR).

#### ▶ Study of the potential for reduction of the use of antimicrobials and anthelmintics for therapy, prophylaxis and prevention to reduce the spread and impact of AMR

- Improved One Health surveillance systems are key to collect currently missing data
- More efficient therapeutic approaches
- Improvement of animal's gut health and preventive biosecurity controls, development of preventive strategies
- Increasing natural disease resistance or disease tolerance of the animals by exploiting genetic diversity
- Exploiting trained immunity in livestock
- Development of new vaccines

#### ▶ Rethinking of innovative management of animal health and implementation thereof with stakeholders

- Identification and implementation of good practices to limit the use of drugs
- Understanding and prediction of human socio-psychology in animal health management

#### ▶ Development of alternatives for therapy, control and prevention

- Utilisation of non-allopathic drugs
- Integrated approach to provide broader based-management strategies

### Expected impact

- ▶ Reduction in antimicrobial resistance;
- ▶ Reduction of antibiotics and anthelmintics, pesticide and biocide use;
- ▶ Improved infection/contact and disease control systems and practical ways to combine actions;
- ▶ Animal genotypes more resilient to diseases;
- ▶ Development of preventive strategies and alternative therapies and use thereof;
- ▶ Reduced losses and improved resource-use, reduction of emission per unit of animal product;
- ▶ Facilitation of free trade of animals and their products throughout Europe and strengthen the European livestock sector's position;
- ▶ More efficient and "country tailored" surveillance systems.

## 3.2. The microbiome from an integrated one-health perspective

### Challenges

With the policy emphasis on developing strategies for improved health and protection from disease, microbiome research has become a priority topic. The numerous interactions between gut microbiota and the host and possible interactions between microbiota of animals, humans and soil underpins the importance of microbiome research. Research has begun to reveal the great importance of interactions between the animal (or human) host and the **gut (and respiratory) microbiome** on the health of the host. Through their natural complexity and the various bioactive metabolites, the microbiota harbours a full range of functionalities that represent a tremendous potential for **health management**, therapeutic intervention and industrial applications of biological chemistry. The microbiota is under the influence of external parameters than can strengthen the immune system and influence its host's development, fitness and metabolism and reduce the use of drugs. The microbiota may also affect animals' behaviour, which in turn may influence their health and welfare. Besides gut microbiota, **respiratory, reproductive tract, skin and mammary microbiota** can also play important roles that are largely unknown at the moment, as well as the interactions between microbiota from faeces, soil and water, especially after manure application, and the fate of bacterial resistance.

### Suggested scopes of research/topics

#### ▶ Early life development and stability over time of microbiota associated with an optimal health and production

- Effects of feed characteristics, host animal and environmental conditions
- Transmission of the microbiomes between animals

#### ▶ Microbiome, microbial metabolomes, their implications on the immune system and host metabolism

- Role of early life intestinal microbiota in immune programming and later life immunity
- Identify the set of microbial species necessary for efficient immune programming
- Understand interactions between commensal and pathogenic bacteria and with viruses
- Animal microbial profiles as early predictors for disease and or contamination
- Role of gut microbiota on animal learning capacity and feed digestibility

#### ▶ Interactions between microbiomes along the food chain in a one-health perspective

- Characterisation of the resistance reservoirs and routes of resistance exchanges with pathogens and other microbial communities

#### ▶ Creation of European network(s)

- Integration of research efforts

### Expected impact

- ▶ Better health and production (One Health);
- ▶ Better control of feed use and modulation of immune competence in livestock species;
- ▶ Reduction in the growth of antibiotic resistance;
- ▶ Animal genotypes and animal systems that are more resilient to disease challenge;
- ▶ Reduced risks to human health;
- ▶ Reduced losses and improved resource use.

### 3.3. Animal welfare supporting animal health and vice versa

#### Challenges

Societal challenges concerning animal welfare are likely to remain an important topic. Some consumers in developed societies are increasingly questioning the ethical acceptability of some livestock production systems. Animal welfare is sometimes included as a benchmark for assessing standards. Major meat and food processing companies are taking a lead in animal welfare issues, particularly by developing guidelines for the supply chain for better welfare practices.

As welfare is a multidimensional concept, its assessment should be a multidisciplinary process. **Rigorous assessment of welfare** may combine both resource- and animal-based indicators which can be measured in various livestock production systems. Animal-based indicators have been developed (FP6 Welfare Quality) but have to be adopted by the farming industry and standardized by the public authorities.

#### Suggested scopes of research/topics

##### ▶ Measuring and evaluating animal welfare

- Adoption of already developed animal-based indicators for animal welfare in practice
- Identification and validation of novel indicators for early detection of behavioural and welfare problems
- Study possibilities of using of iceberg indicators or sentinels as early warning signals

##### ▶ Improving animal welfare

- Improving husbandry conditions
- Breeding to improve animal welfare and consider animal welfare when breeding for other objectives
- Reducing stress and pain
- Generate a good understanding of the animals' affective experiences

##### ▶ Monitoring of progress of animal welfare at policy level, implementation and practices in EU Member States

- Confirm corporate and farming efforts and their effects
- Investigation into how to communicate the benefits to consumers and society

##### ▶ Studying the links between welfare, efficiency, sustainability and health

- Combination of animal welfare improvement strategies with resource use efficiency, economic impact, animal health, sensory analysis of animal product, environmental issues

#### Expected impact

- ▶ Improved animal welfare in EU, ethical acceptability of livestock production systems;
- ▶ More robust animals;
- ▶ Support the livestock industry to open up doors, build corporate responsibility and transparency in a way society understands;
- ▶ Rigorous assessment of animal welfare;
- ▶ New methods and tools to ensure animal welfare in animal breeding and in management practices;
- ▶ Innovative welfare practice guidelines;
- ▶ Better implementation of animal welfare monitoring throughout the production chain;
- ▶ Development of traceability throughout the agri-food chain.

### 3.4. Integrity of food of animal origin and the production system

#### Challenges

Animal products are an important and essential resource of protein, minerals and vitamins in human consumption patterns. They are part of a healthy and balanced diet. But over-consumption of animal products is still questioned for its supposed adverse effects on human health. Animal agriculture is also questioned for ethical reasons: animal welfare, high carbon footprint of diets rich in animal products and the competition between human and animals for food resources. Food processing companies are starting to develop husbandry guidelines for the supply chain.

Facing a challenge to please domestic market and to attain added value from the export of animal products (particularly for a growing middle class requiring high standard of livestock production in some developing countries), it is necessary to amplify quality approaches. More than ever, focus on animal **product integrity (products' safety, authenticity and quality, but also extrinsic qualities like animal welfare, environmental footprint and ecosystem services)** is needed to secure Europe's role as a leading global provider for safe and healthy animal derived products and help European food systems earn consumers' trust.

#### Suggested scopes of research/topics

The following topics are supported by the Food For Life ETP.

- ▶ **Evaluation of the role and impacts of animal products in a sustainable food chain**
  - Evaluation of the sustainability of various agri-food production systems with and without animals
  - Deepening the knowledge about the effects of animal-based products and productions systems on human health and developing strategies to improve their nutritional profile
    - ▶ **Evaluation of the potential of food-derived products in new food and non-food applications**
  - Exploration of the structure and functionalities of eggs and milk proteins
    - ▶ **Building up animal product quality (microbiological, nutritional, organoleptic) all along the value chain**
  - Increasing the potential functional components in animal-derived products that

may reduce the risk of life style diseases and increase their sensory quality

- Increasing the control of animals' microbiota composition on-farm and transmission to the downstream sector to promote safe products with high quality
- Precision livestock farming to create more value for the food chain
- Healthier soils and healthier food products

#### Expected impact

- ▶ Improved nutritional value of animal products contributing to healthier diets in sustainable agri-food systems;
- ▶ Evaluation tools of the nutritional value of animal products;
- ▶ Innovative utilisation of proteins of animal origin both for human health and application in non-food area;
- ▶ Improved traceability of the products of animal origin.

## 4. Cross-cutting issues



## 4.1. Improving infrastructures for research and innovation

### Challenges

There are needs for improvement in research infrastructures, both physical and virtual, for efficiency of delivery and to ensure that European resources are up-to-date and fit for foreseeable purposes. Infrastructures should be seen to facilitate not only enabling research but also innovation, linking research experimental farms, commercial experimental farms, demonstration farms and innovative commercial farms and for harmonisation of ethical aspects for research on animals through Europe.

Livestock research facilities are notoriously expensive to equip and maintain. There is a need to **create synergies between different facilities across Europe**. Bearing in mind the range of different production systems and animal breeds, we also need to increase the research outputs from these units. Whilst **high throughput phenotyping** has been developed for plants and laboratory rodents, it is still in its infancy for farm animals. **Large-scale phenotyping in commercial herds** would pave the way for future implementation of scientific results. Due to genotype x environment interactions, it is important that these herds are spread out across regions and production systems. **Evaluation of innovative production systems** also requires infrastructures of experimental or commercial farms. The **genetic diversity** of European farm animals is a valuable resource that needs to be safeguarded through investment in biobanks of animal tissue.

### Suggested scopes of research/topics

- ▶ **Creation of EU research infrastructures with large populations of farms in combination with research herds**
- ▶ **Creation of a European "large animal clinic" where genome edited animals could be genotyped/phenotyped**
- ▶ **Management of generic resources for efficient multi-omics research**
- ▶ **Improving animal gene banks management and the reproductive quality of gene bank samples for long term conservation purposes**
- ▶ **Strong support to the FAANG international action**
- ▶ **Establishment of an EU-wide network of (i) experimental farms to repeat in various contexts similar trials in animal husbandry and (ii) farm platform rolled out across Europe to encompass all livestock farming systems.**

### Expected impact

- ▶ Optimisation of the utilisation of European infrastructures;
- ▶ Enhance the quality of research methodologies;
- ▶ Deep phenotyping on complex traits;
- ▶ High throughput phenotyping in commercial and experimental farms;
- ▶ More robust and efficient animals;
- ▶ More resilient and efficient production systems;
- ▶ Overall contribution to food security by supporting innovation in breeding and farming sector;
- ▶ Facilitation of knowledge dissemination and implementation.

## 4.2. Precision livestock farming

### Challenges

Precision livestock farming (PLF) technologies give animal production new tools for the management of livestock by **continuous automated real-time monitoring of production, reproduction, health and welfare of livestock**. The advantages are several: the technology is objective, automated, and continuous, it captures the responses of animals, and it provides interpretation of the huge amount of data, providing useful information for making advantageous decisions. The data and information produced by PLF technologies are useful for monitoring and management of production, welfare monitoring and certification, management of the ambient environment, assessment of variation in building design and function, preventive measures and changes in management to enhance health and provision of information on the animal to be used in genetic evaluation (phenotyping)... To reach a more efficient use of resources and at the same time improve animal health and welfare, practical options should be sought for **combining genetic, genomic, metabolomic and phenotypic information** to gain a better understanding of biological processes and to improve selection decisions for livestock.

There are challenges to make data collected from PLF devices a reliable and validated source of information. New techniques for **deeper phenotyping, including metabolic profiling, sensor technology, remote sensing, PLF** on the one hand, **and the genomic revolution** on the other hand, are key elements for successful implementation in the breeding sector. Bridging knowledge and relevant actors will renew predictive biology approaches, generate new knowledge and is crucial for simultaneously advancing smarter farming and competitive breeding.

### Suggested scopes of research/topics

- ▶ **Development of automated data sampling and analysis for further optimisation of efficiency, health and welfare at animal and herd level and nutrient management**
- ▶ **Precision livestock technologies for phenotyping**
- ▶ **Development of ICT/Infrastructure to promote exchange of data between stakeholders**
  - ▶ **Data-driven research**
  - ▶ **Development of predictive biology approaches in PLF**
  - ▶ **New business models for sharing of data and open data sources**
  - ▶ **Research to improve the traceability within the supply chain**

### Expected impact

- ▶ Increased efficiency of livestock production systems; improvement of animal health and welfare;
- ▶ Traceability of the product in a context of “connected plates”;
- ▶ High throughput phenotyping in commercial and experimental farms;
- ▶ Better data capture, compatibility and processing for the optimisation of inputs and yields;
- ▶ Better work condition for farmers; Better understanding of the main reasons for the current lack of adoption;
- ▶ New business models for open data allow use of tools to analyse potential costs/benefits and analyse utility of applications.

## 4.3. Open innovation / Co-innovation

### Challenges

Three major changes occur to the advisory system: i) the development of private (industrial) advisory while professional advisory services have financial difficulties in some countries, ii) the demand for less prescriptive solutions but for accompanying methodologies, empowering farmers to make their own decision, iii) the necessary renewal of the back office of the advisory service, livestock management being more and more complex and requiring an extended domain of skills.

Innovation is at stake for the future of livestock farming. Innovation is coming from research, private industries) and from farmers themselves and the growing amount of information needs very clear and quick channelling to its end users which is currently often missing in many European countries. **New innovation regimes appear:** co/interactive/participatory design and implementation of radical changes. The role of downstream operators in the dissemination of innovations is a core element to be studied. Finally, it is generally recognised that the barriers to implementing new technologies or new management methods are best overcome by **involving the end-user** in the research and development activities, and/or in defining the objectives in the first place.

### Suggested scopes of research/topics

- ▶ Analyse and compare advisory systems
- ▶ Explore the diversification of information systems the farmers are using
- ▶ Identify new professions that analyse and master the profusion of knowledge for livestock development (innovation brokers).
- ▶ Develop new methodologies for co-design of technological innovation
- ▶ Explore on-farm innovation and develop a framework to analyse their interest and conditions for dissemination
- ▶ Knowledge exchange with farmers and industry towards innovation
- ▶ Management and business models in how to run successful animal farms.

### Expected impact

- ▶ Better understanding of the determinants and behaviour of various stakeholders;
- ▶ New way of designing technical and organisational innovations; spotting farmers' innovations, evaluation and diffusion of those innovations;
- ▶ Increase societal acceptance of animal agriculture and new technologies by the society;
- ▶ Design and evaluation of innovative policy instruments and coordination between actors.





animal  
task  
force

A European Public-Private Platform

## The Animal Task Force (ATF)

is a leading body of expertise linking European industry and research providers for developing innovation in the livestock sector.

Our members are research providers from 18 Member States of the EU (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom), plus Norway, Serbia and Switzerland, and industry representative bodies that support the interests of Europe's livestock industries (IFAH Europe, FEFAC, FEFANA, FABRE-TP, ECIP, EU-PiG).

We work together to identify actions that are needed to foster knowledge development and innovation for a sustainable and competitive livestock sector in Europe.

## Animal Task Force

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