A European Public-Private Platform

Animal Task Force's contribution to consultation on Draft paper "A strategic approach to EU agricultural research and innovation", European Commission DG Agri, Directorate H.5.

Link to consultation & draft paper: https://ec.europa.eu/eusurvey/runner/Draft-agriculture-research-strategy

Link to ATF contribution on line: https://ec.europa.eu/eusurvey/runner/74c9b377-d5e0-4d45-a127-f63682505b19?draftid=47ed6a7f-44ff-4fbc-a97e-6d7a65fa7a65

December 2015

1. Why a strategy for agricultural research and innovation?

Do you agree with the main challenges described? Would you like to add other challenges?

The document is clear, comprehensive and opens up for new prospects. The challenges are sound.

The section 1.1. "Major challenge faces by agriculture and food systems in Europe and globally", clearly points that the critical issue in Europe is more to boost all dimensions of the sustainability of production, yet without underestimating the necessity to maintain a sufficient and dynamic production basis in a more uncertain world. Indeed it is more than that. Livestock production can have the ambition to produce more than the European requirements and to export using certain competitive advantages (a generally favorable climate, the sector organization but also the efforts made for reducing GHG emissions and improving animal welfare) that can attract a middle class consumers who will be sensitive to these arguments. Importance of tackling challenges at a global scale and not at EU scale only is highlighted in the introduction of the section but is not sufficiently highlighted in the text.

For the animal sector, the importance and relevance of favoring a more global (international beyond EU) collaboration, in particular with developing countries relies particularly on 1) the need for animal protein from growing population in the developing countries rather than in EU itself, 2) the necessity to reduce carbon footprint of animal protein production at global scale and 3) the international dimension of breeding (i.e. many big breeding companies export/have their products bred all over the world) with the need of working at the global scale on the adaptation of breeds to variable environment (climate, food, pathogens…) and exploring the genetic diversity (interest for more resilient local breeds). International collaborations need to be more facilitated than in the previous programmes and to avoid being country specific.

2. What priority areas for research and innovation?

The priorities areas for research and innovation are in line with the needs for research and innovation of the animal production identified by the Animal Task Force members (see White paper 2013 and first addendum 2014).

Would you like to comment on "cross-cutting issues" (section 2.2)?

Regarding cross-cutting issues, better integration between biological sciences, ecological science and social science is a key issue for developing innovative research and knowledge

based innovations and clarifying the positive roles of animal production in the bio-economy while improving social acceptance of animal production and animal bio-technologies at consumers, citizens and also farmer levels.
Concerning infrastructures we agree with the document and that e-infrastructures are a key issue. Infrastructures should be seen to facilitate not only research but also innovation. This highlights the importance of infrastructures linking research experimental farms, commercial experimental farms and demonstration farms. Among important topics, evaluation of innovative production systems, deep and high-throughput phenotyping and fundamental research in genomics are needed.

Would you suggest changes to the cluster of priority areas "creating value from land: sustainable primary production" (section 2.3.1)?

The cluster of priority areas "creating value from land: sustainable primary production" appears sound and clear. We will highlight some priority areas, some of which are already described in the document, that we consider of the utmost importance. ATF is also supporting the contributions from Fabre TP, EUFETEC and ETP-GAH (IFAH Europe) on these priority areas.

1. **The Key role of animal productions in a circular (bio)economy (ref. p13)**

Circular economy is mentioned without specific reference to animal production. However, livestock production recycles biomass not directly usable for human food to produce food of high nutritional quality, and is a strong engine for the N, P and C cycles, which in turn contribute to the production of biomass. Livestock contributes to the management of biodiversity as well. Animals consume almost all by-products of crops and grains that are not suitable for grain markets. Manure should be considered as a resource that can be better substituted to mineral fertilizers and grassland as well as manure contributes to soil fertility which in turn is favorable for the sustainability of plant production. Apart from its contribution to the regulation of ecological cycles, animal production can also contribute to the bio-economy in two ways: valuation of new resources such as by-products or wastes from agro industry or bio refineries by converting them into animal products which may require the development of new technologies to secure these by-products. The second is the bio-refinery of animal by-products as manure and wastes from slaughterhouse, hatcheries, dairy industries. Affirmation of the role of livestock in a sustainable bioeconomy will require better quantification of the contribution of livestock to ecosystems function, to protein security (including protein quality) and supplying demand for healthy food. It will also require increasing the efficiency of feed chain with a cascading approach (first food then feed and then bio energy), the efficiency and robustness of animal and herds and closing the loops (C, N, P) with mitigation of GHG emission and improved manure management.

2. **Improvement of protein self-sufficiency of European terrestrial livestock (ref. p13, bio-economy)**

Increasing protein self-sufficiency could be realised through increased production and utilization of locally produced proteins such as legumes grain (including locally produced soyabean), grazed pasture, processed forages, protein sources, co-products or residues from the agro-industry and extracted protein/amino acids. In order to develop sustainable and competitive protein sources for European terrestrial livestock production, while not compromising quality and health aspects, the main research and innovation areas concern three domains: 1) evaluation of the nutritional value, health and food safety aspects (thus might imply development of detoxication techniques) of these novel new raw and/or processed protein sources; 2) assessment of ecological and socio-economic sustainability of

the new chains (LCA analysis); 3) facilitation of multi-stakeholder interactions to support market uptake.

3. Developing mixed farming systems and reconsider the role of livestock in ecological approaches is key (ref. p19)

In response to increased market demand, economic pressures, and low price of energy, agricultural systems and territories have become increasingly specialized and mixed farming systems integrating crop and livestock production have strongly declined in many countries or regions. Today only 14% of holdings are mix farming with livestock and crops (Eurostat, 2010). However, mixed farming systems appears to be one major support of ecologically friendly and efficient livestock production systems as they allow to develop local complementarities between Livestock and crops systems and to improve management of manures. Mixed farming system is a particular form of integration between crop and livestock. The mixed farming can be reflected, not only at the level of a firm but also through collaborations between neighboring farms that are themselves specialized. It is important to develop integrated models of crop livestock systems for exploring its benefits and to develop lock-in approaches to innovation to identify brakes and levers of development, including new organization between neighboring farms.

4. Soil fertility including the use of manure as fertilizer (ref. p13)

The Animal Task Force is strongly supporting research on the role of livestock on soil fertility. Soils are storing plant nutrients and filtering water and are stores and sinks for carbon, and habitats that support biodiversity. New technologies (Omics, enzymatic activities) allow to develop more detailed study on the effect of manure application and grassland on soil fertility and sustainability. The increasing biodiversity should confer resilience and higher fertility (C and N organisation) to the soil but the **role of manure which is rich in microorganisms (bacteria, fungi) on the biological life of the soil is not yet known**. The effects may depend on type of soil. On the other hand it is necessary to quantify the risk of manure utilization. This covers the fate of pharmaceuticals (notably antibiotics, anti-parasitic) after manure application to determine the risk of runoff and retention in soil and plants and to characterization of resistance reservoirs of antimicrobial resistance, routes of resistance in food chain and the quantification of the reduction of resistance genes by manure treatments (anaerobic digestion, composting). These questions are also related to the role of livestock in bioeconomy.

5. Supporting the implementation of ICT in precision livestock farming (ref. p14)

Precision Livestock Farming (PLF) is key to achieve more efficient use of resources, combined with better animal production/reproduction health, and welfare through animal individual and (automated or not) real-time monitoring, management and care. The combined use of genetics, genomic, metabolomic and phenotypic information to manage livestock is innovative. Computer databases and data management and analysis facilities are necessary tools for handling huge amount of data relevant to livestock production. Such research data base should be shared through common project and will include data collected by PLF technologies and classical performances data.

The Animal Task Force proposes to create a platform to connect Big Data, High-Tech, Farm Practice Innovations and T&T Food Chain Quality Management. For the moment, PLF is mostly restricted to Engineering (sensors, robotics, (bio)indicators), but this part should be connected to the following three areas:

- The development of predictive biology mathematical modelling, sensors technology, ICT infrastructures (web bases, data basis), standardisation (RFID).

- A development of automated data sampling and analysis including appropriate indicators traits as a key requirement.
- New business models for sharing of data and open data sources should be developed as one of the barriers to make PLF reality is the sharing of data.

Finally, PLF implementation still needs:

- User(farmer)-relevant research at both basic and applied levels;
- Collaboration of all stakeholders, especially farmers, in order to achieve widespread EU farm adoption;
- Support to business-driven innovation to enable a market uptake.

6. Genetic resources, breeding for robustness, health, welfare and resource efficiency (ref. p15 & 16)

Animal genetic diversity appears too much in a framework of preservation of natural resources only. However, animal genetic resources are not only something to preserve, but also something to use in a clever sustainable way. Attention should also be given to genetic resources kept in the conventional breeds.

Activities will stimulate the use of genetic resources as breeds but the use of resource breeds for improvement of the major conventional breeds should be considered, to tackle the need for more efficient, robust and healthy animals to contribute to resource efficiency by reducing resource use and resource loss. Characterization of beneficial traits and genes in both genetic resource breeds and conventional breeds and development of appropriate methods/techniques for transfer of traits and genes between breeds is a prerequisite.

Appropriate phenotypes and appropriate indicator traits that reflect improved resource-use efficiency need to be identified. Selection using genetic, genomic, metabolomic and phenotypic information will allow gains in efficiency, (GHG) emissions, health and welfare. This includes the identification and implementation of welfare indicators that are animal-centered. The combined use of genetic, genomic, metabolomic and phenotypic information is innovative and provide a profound knowledge and holistic understanding of improving resource efficiency - e.g. feed efficiency - in animal production combined with other gains.

Improved breeding programmes for robust animals should include systems of feedback of information from the production chain into the breeding programmes through novel means such as automated data collection and genetic linking through genomics tools. Trade-offs between environmental, economic, health and welfare must be made visible. Interactions between functions (production, robustness, health -inc. immunity, reproduction, fertility, welfare, efficiency) have also to be understood and monitored to improve breeding operations and avoid trade-offs.

Innovative animal biotechnology (new breeding techniques) are a hot topic for social acceptance of livestock production sector. This challenge should be addressed by research especially at a moment of Gene-editing is emerging in animal sciences.

ATF is also supporting Fabre-TP's contribution on this priority area.

7. Integrated management of Health Disease prevention is better than cure (ref. p16)

This paragraph highlights vaccines only for prevention. We need to develop the concept of **integrated management of health** combining at least genetics, nutrition, and environment in addition to vaccines. Health issues should be considered at a global dimension and new diseases arise regularly and continue to do so. Continued risk assessment of new diseases emergence, disease prevention, reducing risks of development of drug resistance, generalised infection control, specific disease control, achievement of a

suitable level of preparedness regarding disease outbreaks and coordinated action remain important topics for research and knowledge development. The possibilities to develop holistic systems biology, improve understanding of disease and drug resistance and use genetic/genomic selection for improved disease resistance have been under-researched, partly because of lack of unequivocal phenotypic parameters for health and disease resistance. Research may focus on integrated health management, antimicrobial resistance, epidemiology, development of new diagnostic tools, intervention strategies e.g. vaccines and novel technologies for disease surveillance and remote monitoring of environment, health and production to assist management, early diagnosis and prevention.

On **zoonosis,** we propose to specifically focus on specific actions that are needed to control notifiable and zoonotic diseases and on selection strategies for the delivery of genotypes with enhanced disease-resistance or disease-tolerance (depending on the disease) and feeding systems. Genetic approaches will depend on identifying easy-to-measure phenotypic markers of health that can be assessed in large numbers of animals. It is advantageous if variables are used for both genetical and management purposes.

On **antimicrobial resistance**, we propose to focus on three main areas of research: i) mechanism of dissemination of antimicrobial resistance with the mechanism of resistance acquisition and the mechanism of transmission: characterization of resistance reservoirs and routes of resistance in food chain with a special focus on the interconnection between human and animal microbiote; ii) the prevention approaches with research on the acquisition and stimulation of animal immunity, innovative therapeutic approaches (including early detection thanks to PLF and new pharmacology), iii) alternatives therapies (phago therapy, plant extracts utilization).

ATF is also supporting Fabre-TP and ETP-GAH (IFAH Europe) proposals on this priority area.

8. Animal welfare (ref. p15, 16, 17)

Societal challenges concerning animal welfare are likely to remain at the forefront, and may represent an opportunity for European animal production to meet consumer demands. Research must include objective and feasible measures of welfare using animal-based indicators. Animal-based indicators for animal welfare have been developed (see ANIMAL WELFARE and AWIN) but have yet to be adopted by the farming industry. Adoption of these systems should be supported in combination with the EIP-Agri. Further research is needed to confirm the reliability of the measures and their robustness, to ensure valid welfare assessment, through a science-based management approach. The assessment of animal welfare requires a good understanding of the animals' affective experiences, including their emotions. Further activities aiming at making the measures practically applicable in commercial farms are also needed.

Other research areas concern improved husbandry systems to stimulate natural behaviour, prevent physical intervention and control potential relations between animal welfare and economy and animal welfare, animal efficiency and environmental issues.

ATF is also supporting Fabre-TP proposals on this priority area.

9. Basic research (ref. p17)

We share the priorities proposed in the document and we would like to highlight a few aspects that are particularly innovative. ATF is also supporting Fabre-TP proposals on this priority area.

Basic research on genetic resources: There is still the necessity for basic research managed at an international scale on e.g. annotation of the genomes (for going beyond the black box of the genomic selection and better linking genotypes and phenotypes), epigenetic marks (which can be taken into account in breeding) transmitted, metagenomics, etc… This

basic research needs to be coupled to infrastructures linking experimental/demonstration farms and breeding industries. There is also an urgent need of collective and pre-competitive appropriation of novel breeding techniques issued from gene editing type techniques (ex. CRISPR-Cas9), which opens complete new area of research and innovation. These researches have also strong links with research on connection between genotype and phenotype for more efficient and healthier animals.

Nutrigenomics: Research is required for improving our limited understanding of the role of nutritional compounds at the molecular level i.e., their interaction with genes, and their subsequent effect on metabolism. This knowledge should allow the rational design of strategies to manipulate body/cell functions through diet; that goal is expected to have an extraordinary impact on animal efficiency, products quality, livestock health and human health as well. Thus, attention should be directed towards nutrigenomics aspects, aiming to investigation the influence of diet components on gene expression profiles and metabolism status. In particular this could be achieved by the study of ways (how and when), during the life of the animal or its parents, to establish specific epigenetics marks favourable for more sustainable animal.

Epigenetics: The function of animal genomes and biology depend on the quality of the gametes from which they come, the conditions at early stages of embryonic development, pregnancy and post-natal stages, largely influenced by its environment or that of his parents. Any environmental stress (climatic, metabolic or behavioral) may change epigenetic marks and result in changes in gene expression, affecting biological functions for periods of varying length or even to be partly passed on to future generations (transgenerational and multi epigenetics). Research is needed to study and delineate precisely the mechanisms underlying these phenomena, especially their duration and reversible appearance: types of stress involved, most critical time, feeding of the relatives during gamete production, feeding of the mother during gestation, farming methods and effects on animal performance after birth. Research will also examine to what extent the inclusion of epigenetic information can improve the predictive value of individual genomic index.

Microbiotas: There is a growing body of evidence showing that the microbial community in the gut helps balance the immune system and influences its host's development, fitness, and metabolism. Better understanding of processes mediating both antagonistic and beneficial symbiotic interactions, and on the dynamics of initiation, transmission, maintenance and dissolution of these complex associations are needed. The installation and manipulation of microbiota in neonates in relation of the strength of immune system and the potential role of probiotics to manipulate this microbiota, the understanding of the barrier function against colonisation/infection towards some pathogens and the effects on the modulation of the immune system are subject of particular interest. New bio-based concepts based on these knowledge should be tested to combat microbial infections and nutrition disorders.

10. Balanced food intake on disease prevention and human health (ref. p13)

This section refers to the introductive paragraph of the 2.3.1 priority (creating value from land) "*The environmental and social dimensions of agricultural production are put under further scrutiny as a result of increasing evidence of the links between food and human health*" (p13) and to the paragraph (p16) that refers to the One Health in its "*broader concept (that) refers to attaining optimal health for people, animals and the environment.*"

While we share those priorities, there is no further reference in the text to the links between food/diet and health, except on the zoonosis and antimicrobial resistance issues, despite the fact that the main societal and economical burden lies in imbalanced food intake responsible for obesity, metabolic syndrome (diabetes, hypertension,...), chronic inflammation, cancers. Those issues were addressed under namely 6th FP with the Lipgen study.

Research at stake is to test the impact of dietary and food supply strategies on the prevention of those diseases; this includes intervention studies (with nutrigenetic and nutrigenomic approaches), nutritional epidemiology approaches, effects on health mediated through microbiotal alteration. Research would also include simulation of food supply/food intake strategies on health; impact of food supply diversification, better understanding of native and intrinsic health properties of foods (animal and vegetal products); alteration of the native properties of foods through processing techniques and consequences on health.

Would you suggest changes to the cluster of priority areas "enhancing rural innovation: modernising rural territories and policies" (section 2.3.2)?

Some priority areas that we consider relevant are less or not present in the document.

1. **Competitiveness and adaptability of livestock farming systems**

This dimension is not enough highlighted in the document. Economically viable animal production systems rely on optimized use of all available resources (incl. natural and financial resources). The EU livestock sector needs to be more resilient to market fluctuations, to be productive and competitive and take advantages of the high EU production standards for export. Areas of research include the analysis of trade-offs between efficiency and adaptive capacity of livestock systems to climate and economic hazards, integration of adaptive capacity indicators in multi-criteria assessment of sustainability of livestock production systems, improved use of financial resources (e.g. capital investment, grants, subsidies, etc.), in-depth understanding of management decisions both at farm and at sectorial level and design and impact assessment of innovative public policies.

2. **Services provided by livestock productions**

Livestock systems provide multiple benefits such as the provision of protein-rich food for humans from inedible resources contributing to food security and employment, as well as supplying non-provisioning 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, 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 while taking into account possible trade-offs and synergies among the supply of ecosystem services, social services, and competitiveness.

3. **Role of livestock for a sustainable rural growth**

In intensive systems, the mainstream commodity system favors work productivity as an essential criteria of competitiveness. However, some collective actions and chain operators have chosen a different path of development, with a differentiation founded on the high quality or the origin of the product supported by a list of specifications. These alternative systems are of particular importance for less-favored areas which will not be able to compete with more favorable regions but even in intensive regions and urbanized regions, local food is also becoming a new market of differentiation. These strategies will help to maintain livestock farming and its provision of services. We need to better know the perspectives of local food development for livestock, on which allegation they can grow (human nutrition, origin, know-how included), to better understand the way the different and contrasted models of livestock and food systems co-exist, compete, or interact, to analyse the adaptive capacities of these systems to face global change.

4. **Innovation for the extension services**

Four major changes have occurred in the rural extension service system: (i) development of private (industrial) consultants while public and/or professional extension services experienced financial difficulties or almost disappeared is some countries, (ii) demand for less compulsory solutions but for enabling farmers to make their own decision, (iii) development of new technologies with high throughput data acquisition and (iv) necessary renewal of the back office of the extension services to develop more holistic approaches of livestock systems because livestock management is more and more complex and requires an extended expertise. Research is needed to explore of the information systems the farmers are using (social networks, information and communications technologies), their influence on farmers decision making, to support a new profession able to analyze and master the profusion of knowledge for livestock development (innovation brokers) and to understand and benchmark extension services, back office, consultancy methodologies and their connection to research.

5. **Transmission of consumers' demand for quality of products along the supply chain**

Perennial determinants of consumer choice for products and for quality of foods (animal or vegetal products) are food safety (nutritional and sanitary safety), sensorial quality, authenticity/naturality and modernity. Each of this axes of quality contain leverages for the competitiveness of the industry and better satisfaction of the consumer. A lot of consideration has been dedicated to the food safety issues in the previous FPs but have abated although those issues are of ongoing concern and evolve rapidly due to the evolution of retailing strategies. The safety, taste, naturality issues of foods are very dependent on congruent organisation all along the supply/value chain. The rapid evolution of ICT and numerical technologies can provide efficient tools for a better transmission of consumers' demand for quality all along the supply chain. The R&D and innovation questions pertain to use of the ICTs to answering the evolving quality demand of a more health, safety, authenticity, hedonism aware consumer, to the alteration of native properties of foods through processing (naturality, authenticity), to short term and long term health impact (cognitive performances, preservation of lean mass, chronic inflammation, diabetes, immune status,...).

3. How will the strategy be implemented?

Would you suggest changes to the approach presented for the implementation of the strategy?

There is a need to support young scientists – could universities apply for funds for PhD students and post docs within this program. Research schools for translational research.

The approach is suggested in the document may not be the best to foster creativity. Too many objectives – need a consultant to write the application.

4. Other comments

One point is also when EFSA (European food Safety Authority) and ECDC (European center for disease control) produce scientific opinions on burning issues very often serious caveats have to be invoked due to lack of knowledge and data. May not be rocket science – but still critical for valid risk assessments. For example the diagnostic sensitivity when testing for salmonella in faecal samples from live birds or pigs, and possible determinants thereof.

A much greater willingness to fund pilot studies – test ideas, foster creativity is needed. Could research organisations and universities apply for funds to be disbursed as small grants programs (20-40 K€)?

In 2.3. “Healthy plants and animals and Disease prevention is better than cure strategy”: It could be highlighted that: Due to “poor funding” and the use of a “syndromic approach”, research activities need to be established for improving our knowledge of the etiology of European endemic diseases and their impacts to be able to develop adapted biosecurity measures and to prioritize development of different vaccines.