Strategy for the Future of Animal Science at the Faculty of Agriculture, University of Bonn, Germany – Status January 2024

1.   Preamble

1.1   Significance of animal production for the economy and society

Animal production generates about half of the agricultural value. Nutrients of animal origin are crucial for a balanced nutrition of humans. It is expected that, due to the growing world population and changing income structures, the global consumption of food of animal origin will increase by 50% until 2050.

1.2   General framework for animal production

Among the diverse factors influencing animal production, which can be different at global and national scales, particularly the shrinking resource availability (water, soil, energy, nutrients), the emission of greenhouse gases and specific requirements on the quality, origin, safety and availability of products of animal origin are of paramount importance. Particular demands are raised specifically at production systems that concomitantly consider animal well-being and environmental friendliness, generating inevitable target conflicts. Solutions for these conflicts require measure, gain of insight as well as gain of knowledge.

2.   Basic structure

Against this background and taking into account the currently available Animal Science facilities, the strategy for the future envisages the following scaling levels (Fig. 1).
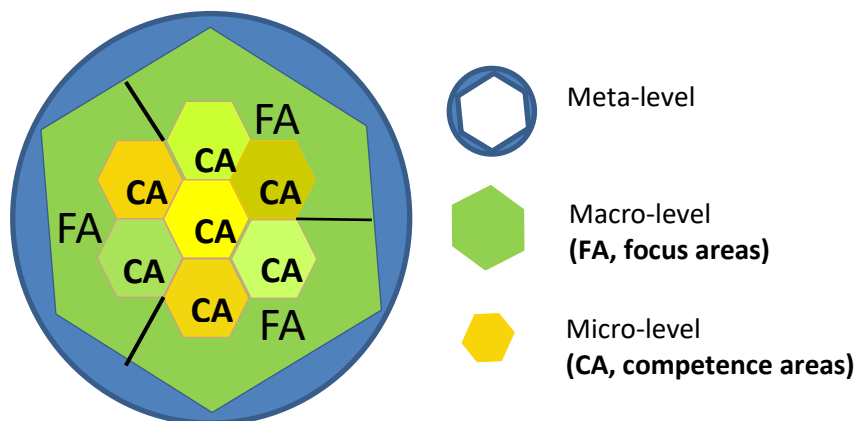

Fig. 1: Structural levels of Animal Science

The **micro-level** constitutes disciplinal working groups, thus representing the rspective competence and realizing the different competence areas into Animal Science. The selection of competence areas takes place at the macro-level (see below). All competence areas must have an international scientific visibility and guarantee a distinct quality of teaching, which

comprehensively covers the specific requirements of Animal Science in the Bachelor and Master degree programs. Human resources and infrastructure will be assigned equitably according to duties and responsibilities. Research in the competence areas is focused on relevant key subjects of farm animal science, which are found in three focus areas. Focus areas as specified below (section 3.2) will be addressed by the disciplinal working groups using an interdisciplinary approach in a matrix format. Together with teaching, the focus areas represent the principal components of the macro-level.

The **macro-level** specifies mission, vision and organization of the future Animal Science at the Faculty of Agriculture, and, together with competence and focus areas, holds responsibility for excellent undergraduate and research-oriented postgraduate teaching. Formally, the macro-level is represented by the Institute of Animal Science and the Livestock Technology Group at the Institute of Agricultural Engineering; with regards to contents, teaching and research are integrated and interacting. Hence, the macro-level forms the level of interdisciplinary integration and documents the integrated competence of the micro-levels into the macro-levels of the research fields. This ensures a flexible and solution-oriented approach in research and a complete coverage in teaching in terms of a substantiated education.

On the other hand, the macro-level is part of the **meta-level** and reflects the network of interactions (disciplinarity, interdisciplinarity and transdisciplinarity) of the macro- and micro-levels with regional, national and international research and co-operation partners (synergistic competence; Fig. 2). The meta-level constitutes the network of all research activities (with, e.g., institutes of the faculty, Center of Integrated Dairy Research [CIDRe] at the University of Bonn, regional and national associations and groups) and allows the integration of the macro-level into the national and global research community.
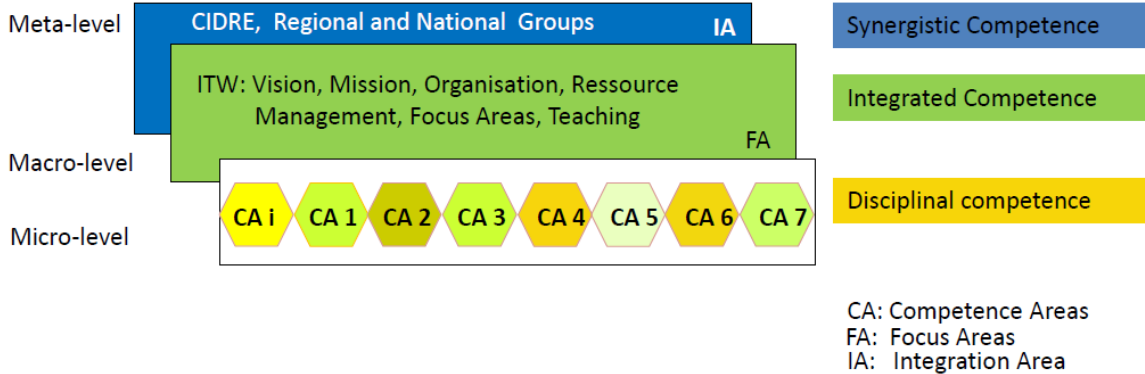
Fig. 2: Competence levels

3. Specification

3.1 Micro-level

The micro-level consists of eight competence areas (Tables 1 and 2). Each competence area is typically represented by a working group, which works with the necessary focusing to fulfil the tasks. Th central and integral feature of Animal Science at the Faculty of Agriculture is the Educational and Research Centre Frankenforst, part of the Off-Site Laboratories Agriculture, Geodesy, Nutrition (acronym 'AGE' following the German terms).

Table 1: Competence areas of the micro-level

Central Unit		Competence Areas
Educational and Research Centre Frankenforst	1	Livestock Technology
	2	Animal Nutrition
	3	Environment and Animal Health
Experimental	4	Physiology
Platform	5	Livestock Behaviour and Welfare
for all	6	Statistical Genetics
Competence	7	Animal Breeding
Areas	8	Quality of animal-derived food

Table 2: Working groups and competence areas of the micro-level

|	Working group	Competence
1	**Livestock Technology**	Animal Appropriateness, Environmental Impacts and Resource Use Efficiency, Precision Livestock Farming
2	**Animal Nutrition**	Feed Evaluation, Nutritional Physiology, Ration Planning, Nutrient Use Efficiency
3	**Environment and Animal Health**	Livestock-Environment Interactions, Resilience and Adaptation, System Fitness and System Performance, Microbiome
4	**Physiology**	Growth, Immunology, Reproduction, Lactation
5	**Livestock Behaviour and Welfare**	Behavioural Biology, Animal Appropriateness and its Indicators, Animal Protection
6	**Statistical Genetics**	Populations, Modeling, Breeding Planning, Bioinformatics
7	**Animal Breeding**	Genotype-Phenotype-Mapping, Genomics, Epigenetics
8	**Process-related quality of animal-derived food**	Food Quality (from a nutritional, organoleptic and technological point of view), Risk Assessment, Influencing factors

3.2   Macro-level

3.2.1   Research

Mission: Research for a sustainable production of food of animal origin tailored to suit both animal and market needs

Vision: Identification of **adaptation requirements** on the value-added chain "animal production" for a **biodiverse, healthy, animal-appropriate livestock husbandry, adapted to the location**

Under the prevailing general conditions, performance, resource efficiency, emissions and animal welfare will play a distinguished role in the future, in which most notably the interdisciplinary combination of requirements in terms of **animal welfare** will be in the foreground. To achieve this goal, a double adaptation is needed:

Adaptation of the environment **(pre-adaptation)** (e.g., husbandry, feeding) to the needs of animals and adaptation of the animal to general environmental conditions **(post-adaptation)** (e.g., animal-appropriate husbandry conditions, climate change, scarcity of raw materials).

This environment-animal-environment (EAE) concept secures the demand of animals for a live-able keeping, considering also general economic conditions. It requires a scientifically sound identification and development of **adaptation mechanisms** from the perspective of the animals and the animal environment (Fig. 3).
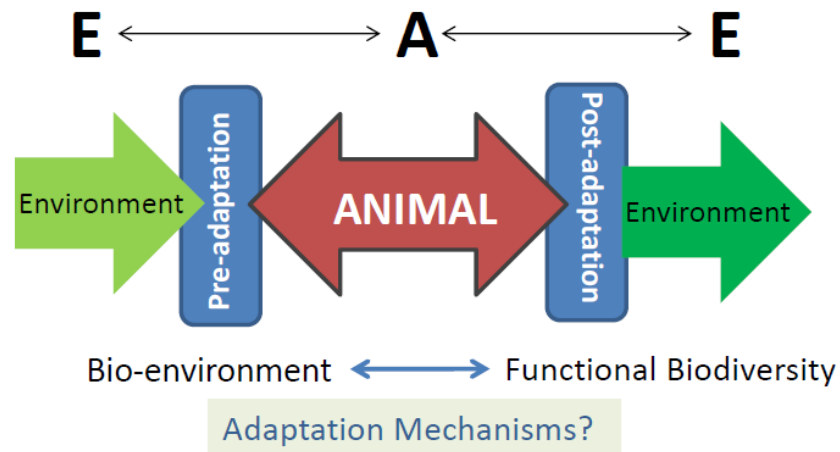
Fig. 3: The Environment-Animal-Environment (EAE) research approach of Animal Science

To enable the realization of the vision, the macro-level will identify three focus areas (FA), which will serve as interdisciplinary main research lines. Combined with the disciplinary competence areas, a matrix structure will be built, which is a **unique feature** (Fig. 4).

FA1:   **Performance and homeostasis**
        Buffering capacity of the organism against challenges

FA2:   **Resource use efficiency and environmental impact**
        Room for improvement of resource efficiency (retention and excretion), minimization of greenhouse gas emissions

FA3:   **Functional fitness**
        In-depth understanding of resource allocation for and regulation of functional traits (e.g., reproduction, disease resistance, immunological fitness, behaviour)

Fig. 4: Matrix structure of competence and focus areas

To enable the implementation of the EAE concept, the AGE Off-Site Laboratory, Educational and Research Centre Frankenforst, is of mandatory relevance for animal science research. By

means of advanced technical facilities, the Centre facilitates the exact measurement of complex traits (precision phenomics).

3.2.2 Teaching

Content of teaching and capacity for teaching of the competence areas will be systematically harmonized (task of the macro-level).

3.3 Meta-level (Integration)

Excellent research is not imaginable without structural interconnectedness with internal and external partners (disciplinal, inter-disciplinal and trans-disciplinal). Therefore, Animal Science considers that an intensification of mutual trade-offs is important and expandable – within the faculty (working groups at all institutes of the Faculty of Agriculture) and with regional, national and international partners. A number of trade-offs (e.g., with CIDRe, FNC [Bonn International Center for Food Chain and Network Research], joint proposals submitted to the Federal Ministry of Education and Research and the Federal Ministry of Nutrition and Agriculture or the EU), have already been established or are currently being established. The extended strategic development of international relationships will allow to expanding the excellence in research and is a key concern of the macro-level of Animal Science.

Overall Animal Science at the Faculty of Agriculture consists of eight competence areas (CA) and three focus areas (FA), which are interlinkd at different levels through integration areas (IA) (Fig. 5).
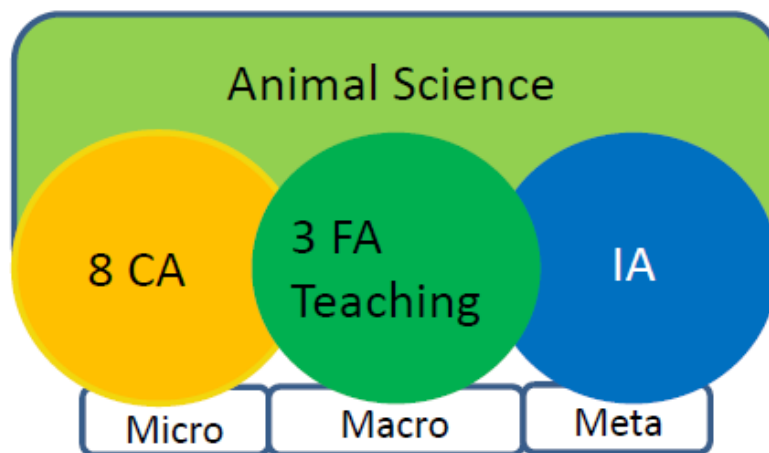
Fig. 5: Integrated strategy for the future of Animal Science