SusTradeOff - Understanding Trade-Offs between health and efficiency to improve competitiveness and Sustainability of animal production by breeding and management

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1ST SusAn COFUNDED Projects Seminar
23-24 November 2017, Bilboa (BC, ES)

EUROPEAN RESEARCH AREA ON SUSTAINABLE ANIMAL PRODUCTION

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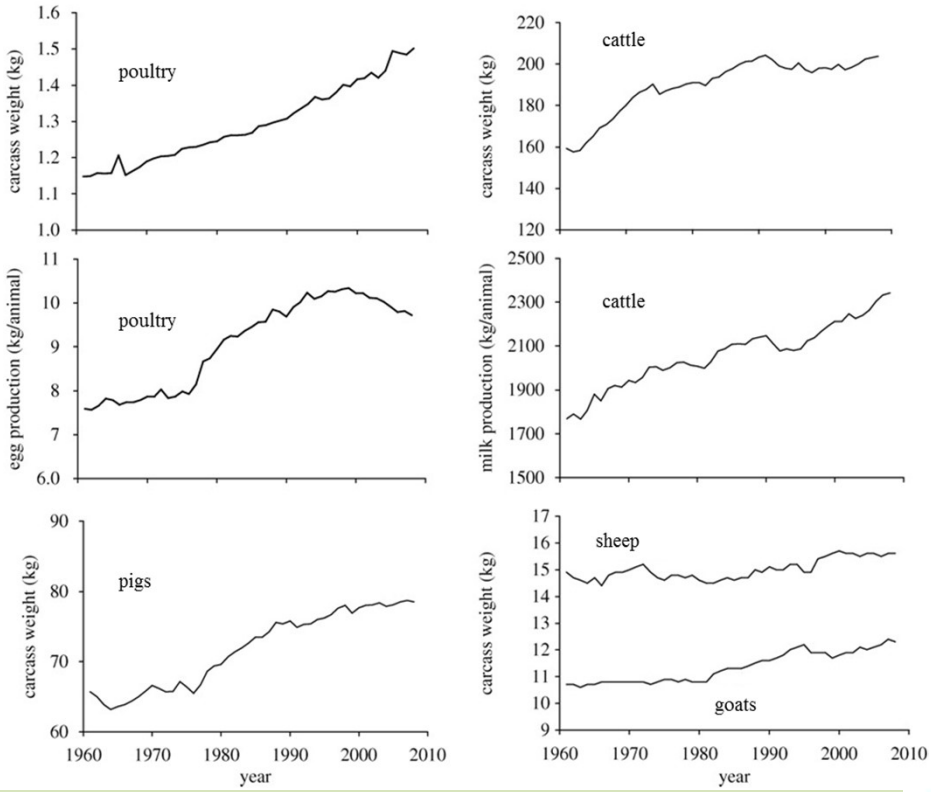
Hypothesis:

Selection for liveweight gain and egg/milk yield in production animals has resulted in resources being allocated to production, at the expense of other physiological processes such as immune function

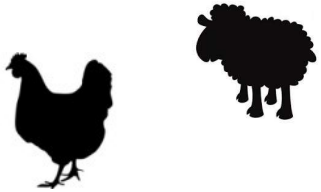


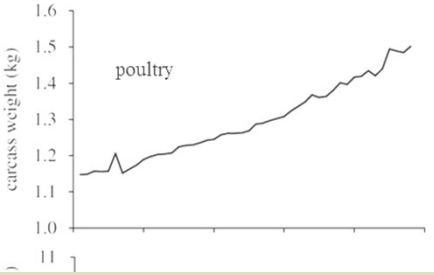
Global change in livestock carcase weight, milk production and egg production 1960-2010 (adapted Thornton 2010)

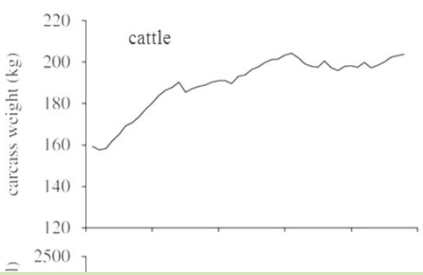
Goals:

Selection for liveweight gain and egg/milk yield in production animals has resulted in resources being allocated

to production, at the expense of other physiological processes such as immune function

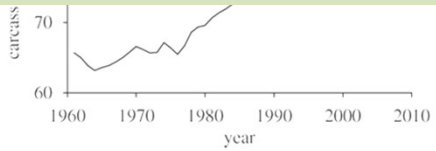


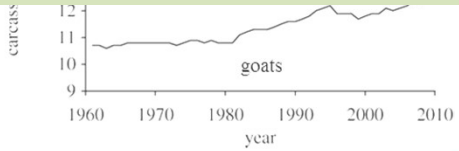




➢ **Understand these trade-offs, to improve competitiveness and sustainability of animal production by breeding and management**

➢ **Understand in two production systems (sheep and poultry) how protein diets, genetics, stage of production, disease or vaccination affect protein allocation between production and immune function**





Global changes in livestock carcase weight, milk yield and egg production 1960-2010 (*adapted Thornton 2010*)

Objectives :

One of the most expensive inputs = Protein !

⇒ **Improving the protein status of animals can reduce the impact of infectious diseases !**

BUT

- **How different dietary protein sources are allocated ??**
- **How this is affected by production, disease or vaccination ??**

Measuring in vivo synthesis rates of proteins associated with production & Immune Function

⇒ **Selection of cheaper protein sources without compromising physiological function or targeted supplementation to maintain Immune Function in the face of high production**

⇒ **= Additional phenotype in balanced breeding programmes, to allow selection of individuals with improved production traits that maintain sufficient resources for Immune Function.**

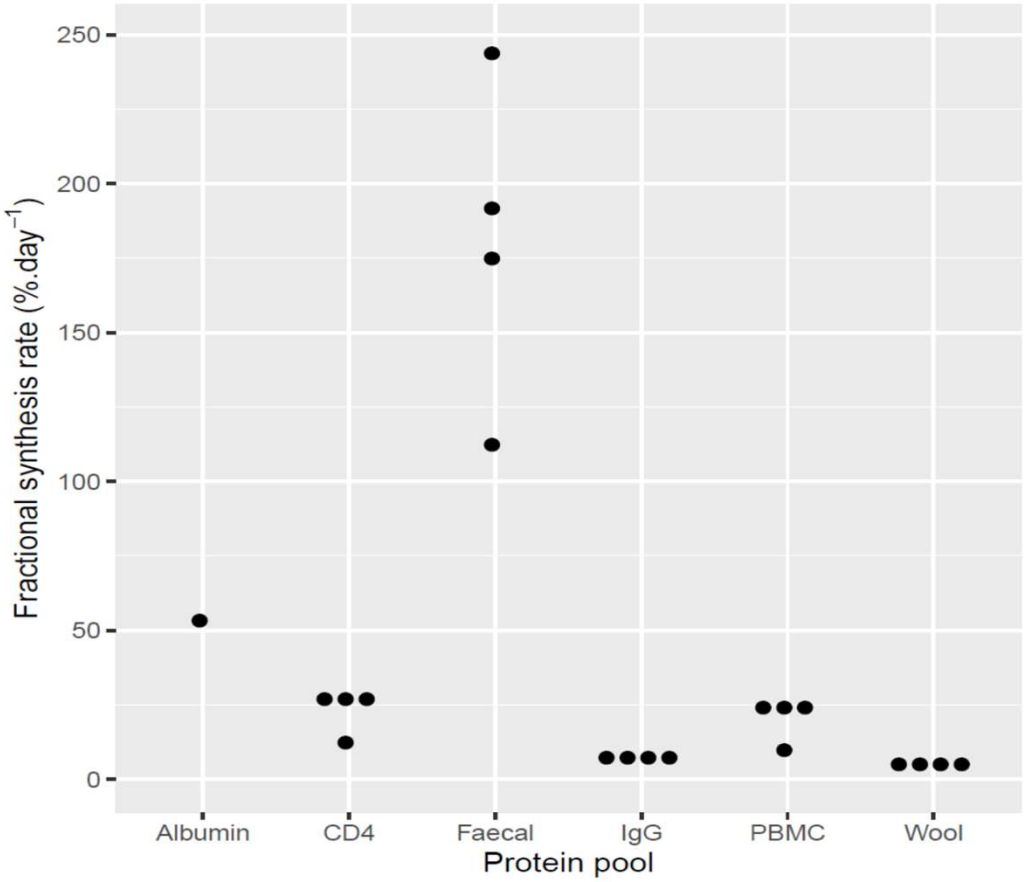
HOW Measuring in vivo synthesis rates of proteins ??

Objectives … -> Challenge !

Measuring in vivo synthesis rates of proteins

⇒ **Use of deuterium oxide (D2O) in humans = minimally invasive approach to measuring the Fractional Synthesis Rate (FSR) of proteins**

⇒ **Proof of concept in sheep**
Not in chicken !



Estimate FSR of:
serum IgG, albumin, PBMC proteins,
CD4+ T-cell proteins,
faecal & wool proteins
(1 wk following D2O administration)

Challenge :

Measuring in vivo synthesis rates of proteins

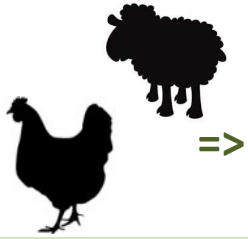
⇒ **Use of deuterium oxide (D2O)** = allows FSR of protein pools to be measured, but doesn't allow the FSR or total amount of individual proteins within the sample to be calculated.

⇒ **QconCAT technology !**

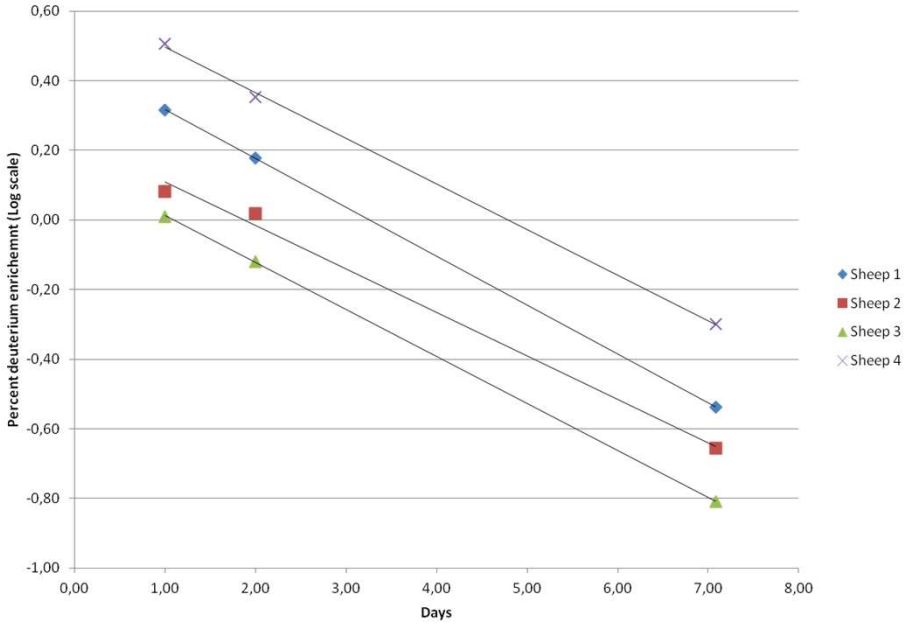
(***stable isotope labelling of protein-specific peptides that can be used as internal standards to quantify levels of multiple individual proteins within a sample***)

⇒ **Used in pigs, cattle and horses, BUT not poultry or sheep !**

⇒ **Absolute quantification of turnover rates & of individual proteins + measured simultaneously in vivo**

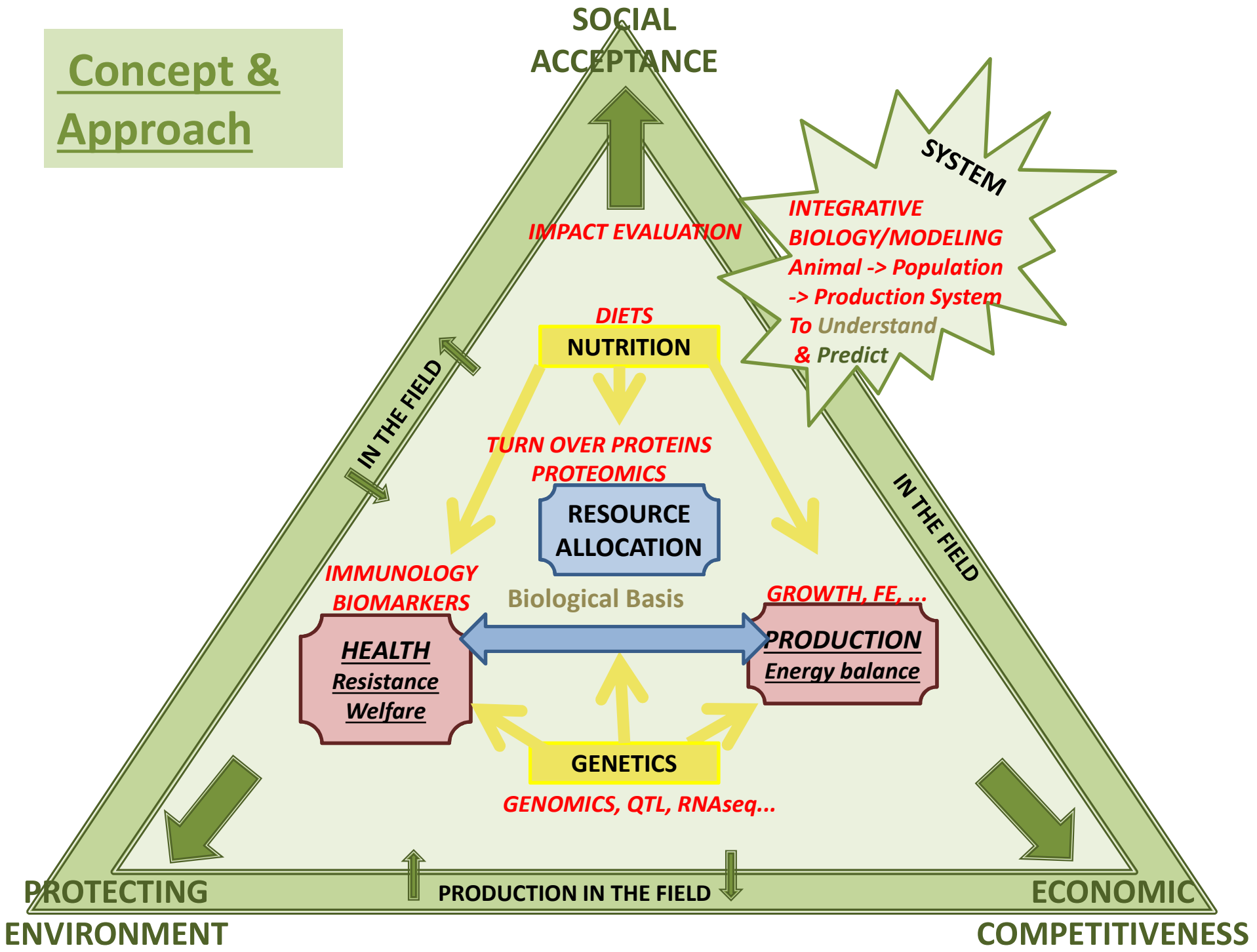


=> INNOVATION !



Total body water deuterium enrichment of weaned lambs (following oral administration of D2O)

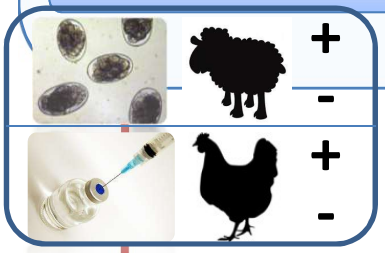
Concept & Approach



In practice : …

WP1: Biological basis of resource allocation

- 1.1: D_2O protocols and sample generation
- 1.2: QconCAT platform development
- 1.3: Resource allocation models



X

WP2: Genetic basis of resource allocation

HENDRIX GENETICS

- 2.1: Genetic background of trade-offs
- 2.2: Resilience and immunocompetence in lines
- 2.3: Integration of heterogeneous omics data
- 2.4: Epidemiogenetic modeling of trade-offs

WP3: Towards sustainable production systems

- 3.1: Field investigation for sustainable systems
- 3.2: Environmental impact evaluation in sheep
- 3.3: Eco/environmental impact evaluation in hens
- 3.4: Stakeholders and social acceptance

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Consortium : Complementarities & Integrated Partnership

	WP1:Biological basis of resource allocation			WP2: Genetic basis of resource allocation				WP3:Towards sustainable production systems				*EXPERTISES*						
#- Partners	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	Sheep	Poultry	*Proteomics*	*Genetics /Statistics*	*Immunology /VetSciences*	*Field Impact*	*Production Systems*
1-INRA COORD. -GABI			P			L	P			P	L				*P*	*S*		
2-Wageningen Univ.				L	L	P			P	L	P				*P*			*P*
3-Aarhus Univ.		L	P								P			*P*				
4-Edinburgh Univ.	L	P	P				P		L		P				*S*	*P*		
5-Moredun RI	P	P	P								P			*S*		*P*		
6-INRA -GENPHYSE			L			P	L	P	P		P				*P*	*S*		
7-IDELE								P	P		P						*P*	
8-Cobb -Vantress										P	P				*P*			
9-Hendrix Genetics				P	P					P	P				*P*			
10-ITAVI								L		P	P						*P*	
11-Okologisk								P	P	P	P						*P*	

Knowledge Institute

Technical Institute

Breeding Company

Farmer Organization

Task #	
Leader	Participant

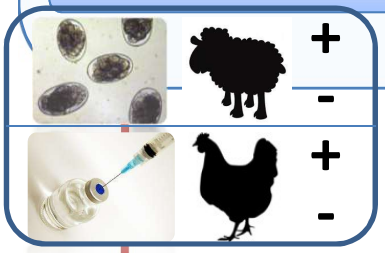
EXPERTISE	
Primary	Secondary

+ Related National & EU projects (SAPHIR, FeedAGene, PARAGONE) ..

Preliminary Results

WP1: Biological basis of resource allocation

- 1.1: D_2O protocols and sample generation ✓
- 1.2: QconCAT platform development ✓
- 1.3: Resource allocation models ✓



X Diets + -

WP2: Genetic basis of resource allocation

- ✓ 2.1: Genetic background of trade-offs

- 2.2: Resilience and immunocompetence in lines
- 2.3: Integration of heterogeneous omics data
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Potential Impacts : Integrated impacts at different scales


❖ At the Animal level:

- ✓ Novel proteomics tools & methodology to measure protein turnover in sheep and poultry
- ✓ Detailed understanding of the role of genetics and dietary protein underlying healthier and more resilient animals

❖ At the Population level:

- ✓ Usefulness of Nab in poultry breeding for more resilient animals
- ✓ Usefulness of resilience in sheep and poultry breeding
- ✓ Better understanding of actual trade-offs in breeding populations

❖ At the Production systems level:

- ✓ Novel breeding strategies and practices and more efficient use of protein resources
- ✓ Food and breeding industry more competitive and resilient
- ✓ Better share of natural resource and reduced carbon footprint
- ✓ Reduced drug residues and resistance
- ✓ Better societal acceptance

Stakeholders and expectations

Stakeholders:

- ✓ Poultry breeders :
- ✓ Organic farming :
- ✓ Outside SusTradeOff : breeding

* Dissemination of operationally validated proposals for improvements of breeding /on-farm practices
* Workshops with stakeholders (EU projects e.g. FeedAGene, SAPHIR), policy makers and vet practices

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THANK YOU FOR YOUR ATTENTION !

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