



**One-day symposium of the Animal Task Force
& the EAAP Livestock Farming Systems commission
Monday 30th August 2021
EAAP Annual Meeting 2021 – Davos, Switzerland**

Sessions report

Table of contents

Welcome and Introduction	3
Mixed crop/livestock systems - do they deliver more resilient food systems? (EAAP session #07)	4
<i>How to re-implement synergies between crops and livestock farming? A research and innovation perspective</i>	4
Outcomes from the ATF and Plants for the Future ETP workshops and webinars (2018 to 2020) ..	4
Development of plants with improved composition for animal nutrition, animal health and welfare and animal product quality – successes and opportunities	4
Reducing the feed and food competition: perspectives and best practices	5
What can plant breeding do to better feed animals?	5
Novel feed from crops and crop residues, vision from the feeding industry	6
Animal breeding towards the valuation of new feed	6
New Phenotypes for grass utilisation under grazing to improve grass breeding	7
Improving resilience of organic beef-sheep farming systems	8
Does integration promote sustainability in organic multi-species livestock farms	8
Pulses and oilseed rape for food and feed	9
Panel discussion with speakers and the audience	10
Going beyond the Feed vs Food competition: crops and animals together to address food and nutrition security (EAAP session #17)	12
Novel concepts & methodologies to assess the role of livestock farming in sustainable food systems	12
Novel concepts and methodologies around the assessment of sustainability in livestock farming: One Nutrition	12
Adjusting feed conversion ratio methodologies considering the added value of animals to valorise non-consumable fractions of plant products and biomass from marginal lands	12
Evaluate the land-use efficiency of regional livestock systems from a food systems perspective ..	13
A partial Life Cycle Assessment of smallholder livestock systems in Western Kenya	14
Policy making, environmental, territorial and economic soundness, social acceptability of novel options for reconnecting crops and livestock sector	14
Restoring or reinventing the virtuous cycle of crop-livestock integration?	14
Panel discussion with speakers and the audience: What are your ideas, suggestions for R&I topics?	15

Since 2013, the ATF-EAAP Special Session during the EAAP Annual Meeting aims to bring together animal science with practice of animal production and connect researchers, policy-makers, industry representatives and societal organisations. Every year, a different topic is addressed during a half-day session. <http://www.eaap.org/>.

Background

One of the controversial aspects of livestock production is the resource competition for feed and food production that requires a disruptive shift in resourcing animal feeding and in European agriculture. Only 20-25% of annually produced terrestrial agricultural biomass (crops and grasslands) is edible as human food. Thus, animals are very useful to convert the remaining 75% into edible food and manure that is a source of nutrients and carbon for plants and soils. This is basically a virtuous circle. However, in response to increased market demand and economic pressure, some agricultural systems and territories have become **increasingly specialized**. At the same time, productivity in the agricultural sector has largely increased and mixed farming systems **integrating crop and livestock production** have strongly declined in some countries or regions. Modern agriculture has developed with livestock and crop production becoming more intensive, and at some places more specialised and spatially separated which has resulted in an **imbalance in nutrient flows with negative impact on the environment**. To achieve the conditions required to deliver more sustainable farming systems, it is essential to **develop science-based management strategies that reduce the current reliance on non-renewable resources** and securing the production in an increasingly unpredictable climate. Such solutions focus on **sustainable land use and the interconnection of arable and livestock systems as part of a circular and sustainable bio-economy at different scales**.

Format of the one-day symposium

In 2021, the EAAP Livestock Farming Systems Study Commission and the ATF Special Session have joined into a one-day symposium. The symposium would like to engage discussion with farmers, industries, scientists, policy-makers and with the society. Most important findings will be discussed with a panel. The outcomes of the session will be discussed with a large panel of European stakeholders during the ATF seminar, in Brussels, on 18 November 2021.

Aim

This one-day symposium aims to contribute to:

- **Engage a dialogue with various stakeholders;**
- **Address how research and innovation can support the livestock sector;**
- **Provide input to European research and innovation agendas and to public policies** to secure Europe's role as a leading global provider of safe and healthy animal-derived products;
- **Support knowledge development and innovation;**
- **Foster ownership by farmers and industries.**

Welcome and Introduction

Frank O'Mara, Tommy Boland and Isabel Casasús introduce the session and welcome participants.

The Animal Task Force (ATF) promotes a sustainable and competitive animal production in Europe. We are a public-private partnership of experts from knowledge institutes and industry representative organisations from across Europe. We work closely together with EAAP on setting the European agenda for research and innovation in the animal domain.

For more information:

www.animaltaskforce.eu

@AnimalTaskFrc

www.eaap.org/

@EAAPofficial

All presentations are available on the [ATF website](#).

Mixed crop/livestock systems - do they deliver more resilient food systems? (EAAP session #07)

How to re-implement synergies between crops and livestock farming? A research and innovation perspective.

Outcomes from the ATF and Plants for the Future ETP workshops and webinars (2018 to 2020)

By Amrit Nanda, Plants for the Future ETP - @Plant_ETP & Jean-Louis Peyraud, INRAE - @PeyraudJean

Amrit Nanda is the executive manager of Plants for the Future ETP. She holds a PhD in Plant Sciences from the Australian National University. Jean-Louis Peyraud is Deputy Scientific Director of Agriculture at INRAE, in charge of animal production. He is currently president of the Scientific Interest Group "Avenir Elevages" which brings together French actors (research, education, extension services) involved in animal production. He is former chair of the ATF.

The Farm-to-Fork strategy opens the way towards a rejuvenated agriculture that stays within planetary boundaries. The ATF and the "Plants for the Future" European Technology Platform (Plant ETP) recognize the urgency of transition and published, in 2019, R&I opportunities for the crop-livestock value chain. The proposals aim at developing a climate change-mitigating, circular, resource efficient agri-food system with closed nutrient cycles, healthy soils and ecosystems, restored biodiversity and attractive landscape. Local re-integration of livestock and cropping offers new opportunities to reduce the environmental footprint and restore ecosystems functions, soil quality and organic content. **The ability of livestock to utilise a broad range of biomasses could help diversify crop rotations, close nutrient cycles, reduce pest pressure and chemical inputs, and enhance biodiversity.** Three recommendations were developed: 1. the **upgrade of LCA to track progress towards more sustainable farming** by assessing the interactions between crop and livestock sectors in a circular economy, and to properly evaluate biodiversity, economic and social (employment, rural vitality) performances of value chains; 2. the **optimisation of synergies in circular livestock-cropping systems** covers identification and development of innovative cropping systems allowing for permanent soil cover and livestock farming systems as well as genetic improvement of plants and animals to maximise resource use efficiency and development of biorefineries in support of circularity to maximise the utilization of products and by-products as well as N and protein from manure and green biomass; 3. Governance, roles of stakeholders and public policies to promote changes over time, meaning **actors coordination to change the socio-technical system and design of public policies to guide and support transitions.**

[More information in the slideshow](#)

Development of plants with improved composition for animal nutrition, animal health and welfare and animal product quality – successes and opportunities

By Michael Lee, Harper Adams University - @HarperAdamsUni

Professor Michael Lee is an expert in sustainable livestock systems, defining their role in securing global food security at the same time as protecting environmental health (Livestock's role in human and

planetary health). He is President of the EAAP Livestock Farming Systems Commission and of the British Society of Animal Science.

There is an ever-growing demand to improve plant composition for animal nutrition which will not only improve performance and the quality of the animal-derived food but will also result in a lower environmental footprint. Michael Lee and Jonathan Napier have investigated some successes and opportunities for ruminant and monogastric livestock systems for improving feed supply through plant genetic improvement. Breeding forages has provided a means of improving the efficiency of milk and meat production at the same time as reducing environmental pollution at a minimal cost to farmers. Genetic gains in early spring growth and annual dry matter yield have been a major focus. However, improving the nutritive value of forage has also played a significant role through maximising microbial capture of nutrients in the rumen and improving efficiency and product quality. Novel plant traits could be incorporated into future breeding programmes. For monogastric livestock, supply of long chain omega-3 PUFA could be successfully modified through application of microsomal elongase activity technology. **This technology offers great potential in providing a sustainable terrestrial source of fish oils and represents the most sophisticated plant metabolic engineering to date to undergo environmental release.** Such plant-based feed approaches to feed our livestock either to improve animal performance, reduce environmental pollution or address a sustainability feed supply issue, is critically needed to realise the true potential of livestock within future sustainable food systems.

[More information in the slideshow](#)

Reducing the feed and food competition: perspectives and best practices

What can plant breeding do to better feed animals?

By Max Schulman, farmer - MTK - @max_schulman

Max Schulman is a Finish farmer. He was Chairman between 2013 and 2019 of the Cereals Working Group in Copa-Cogeca, is member of the EU Arable Crops Market Observatory and 2018 - 2020 Vice Chairman of the Civil Dialogue Group, Arable Crops and from 2021 – Chairman of the Agri-Food Chain Roundtable.

Max Schulman reflects on his challenges as an arable farmer today. Imports of protein crops are under scrutiny of the EC and member states, pushing to include crop proteins in crop rotations and resulting in a need to speed up plant breeding and develop farm grown crop proteins. This raises scientific issues around the protein crop composition, resilience, robustness facing draughts, pouring rains... We need to make sure that production of protein crops will increase in the arable sector and have enough arable farmers involved. We have made trials showing that prices may follow when we have a market. I do not see a big challenge around the feed vs food competition: each sector will complement each other. **We need a plant breeding sector growing proteins fitting EU soils, competing with cereals in terms of farmers revenue.** We have made a lot of efforts in bringing up cereals yield. We need to secure the arable sector in terms of quantities and market. Also, growing conditions are different from Southern to Northern parts of the EU. We need good local plant breeding and support from the animal sector to drive a sufficient crop rotations supply to a sustainable level, meeting EU policies in terms of biodiversity and sustainability. Looking at different kind of crops to develop among peas, beans, soybeans, lupins, extracting protein from clover, grasses, one big source of protein is still cereals, and the challenge is to compensate imported feed. Multipurpose crops may be a solution provided that they reach quality standards and affordable price. We may also look at winter varieties, and on the research side at the animal digestibility. Finally, we need to sit down between plant breeding, the farming sector and the feeding sector, bridge the gaps across some areas where there is too much

specialisation, bring them altogether to make up new types of crop rotations towards feed and food uses. We also need better risk management systems for protein crops that have little bit more risk.

Novel feed from crops and crop residues, vision from the feeding industry

By Ruud Tijssens, Agrifirm Group - @RuudTijssens

Ruud Tijssens is Director Public & Cooperative Affairs of the Royal Agrifirm Group, the Netherlands. He has a vast experience in the area of research and innovation and the public and political domain. He was former president, now board member of FEFAC, Nevedi (the Dutch feed industry association) and is engaged with the International Feed Industry Federation.

The role of animal production is changing at this moment, with a reduction of the animal protein in the diets. Feed, food, biomass production are topics to face and land utilization will be a key indicator concerning to feed the world's ever-growing population. Substantial challenges must be considered: a reduction of greenhouse gas emissions, biodiversity, animal welfare and health, the fight against zoonotic diseases and reduction of the risk of antibiotic resistance are important ones. Animal production plays an important role in the valorisation of non-edible products, and by that in optimal land use. And livestock farming is playing a very important role in generating income to low class population in many developing countries in Asia and Africa. So, what does this mean for feeding animals? We should not feed animals products which are in competition with food products. But what would be the practical consequence of this? Agrifirm made a model, based on a discrimination between primary raw materials, co-products, former food stuffs and other ingredients. The key-indicator is introduced: percentage fit for feed use.

At the same moment, part of the transition is clear: the European Protein Plan is a very important topic, but this transition is not an easy pathway, because arable crop farmers are looking to optimal financial revenues in balance with the biodiversity and soil fertility. **Some examples of the struggles and challenges in the development of European soy, fababeans and other crops need to be highlighted.** Also, the amount of food waste in Europe is huge: 90 million tons. As a comparison, the entire compound feed market in Europe is 150 million tons. At present, about 6 million tons of these former foodstuffs are being used as feed, so the potential is substantial. But what are the conditions under which this will be an affordable and most important safe feed stock for live animals? But at the same moment, many opportunities are in front of the feed industry. Scientific development, together with developing new business models will play a key role in this development. This is an important path forward, in line with Agrifirm's vision: a responsible food chain for future generations.

[More information in the slideshow](#)

Animal breeding towards the valuation of new feed

By Lisanne Verschuren, Topigs Norsvin - @TopigsNorsvin

Lisanne Verschuren is a junior researcher in pig genetics and nutrition at Topigs Norsvin Research Center B.V., The Netherlands. She has a Master in Animal Science obtained at Wageningen University in 2016 and started as an external PhD candidate at the Animal Breeding and Genomics group of the same university that year. In the past years, she has been working on fecal microbiota, blood metabolites and nutrient digestion in relation to feed efficiency in pigs.

Pig breeding has, so far, mainly focused on improvement of efficiency and robustness with high quality and digestible diets as a given. Since cost of feed is around 75% of cost of livestock production and pigs eat almost everything, **recycling by-products of the human food industry is a serious option to be**

improved. Feed efficiency is most often expressed as kg/kg or energy intake over weight gain. With restrictions on human edible resources and environmental influence of pork production, the definition of efficiency changes towards nutrient efficiency, i.e. nitrogen efficiency and fibre digestibility. After ingestion of the feed, most dietary nutrients are made available for absorption by the animal itself, whereas the fibrous part of the diet can be broken down by the intestinal microbiome. The digestion of dietary nutrients decreases at a higher feed intake, hence the ad libitum feeding as standard in worldwide pork production is suboptimal. Feed intake potential of animals should be high enough to allow for sufficient ingestion of less balanced feed in the future. But feed intake should also be resilient for changes in feed ingredient composition and quality. If management of farms will allow for restricted feeding, then genetic selection can focus on optimizing feed intake and increasing digestion of nutrients. Right now, as an immediate solution for resource efficiency, exploiting genetic variation in existing production populations could be considered for precision feeding. Sensory technologies can help to follow animals through their productive life, optimizing the combination between their genetic potential and the available feed resources.

[More information in the slideshow or the video](#)

New Phenotypes for grass utilisation under grazing to improve grass breeding

By Tomás Tubritt, Teagasc - @teagasc

Dr. Tomás Tubritt is a research technologist at Teagasc Moorepark, the Irish dairy research centre in Ireland. He completed his PhD last year from Queen's University Belfast and researched perennial ryegrass variety evaluation.

The proportion of grazed grass in dairy cow diets in Ireland is estimated to be 80%, with silage and concentrates accounting for a further 20%. Perennial ryegrass is the main forage species sown in Ireland, as under temperate conditions it produces large quantities of high-quality feed, persisting for many years under correct management. Farmers conduct pasture reseeding to increase the proportion of sward perennial ryegrass. The Pasture Profit index (PPI) is used to select grass varieties for reseeding. The PPI is an economic variety ranking index which identifies the most profitable perennial ryegrass varieties for reseeding. Grassland farmers aim to optimise the proportion of grazed grass in animal diets as high pasture utilisation maximises farm profits. Perennial ryegrass varieties influence grazing management and utilisation but until recently no indication of a varieties ability to be grazed was available. As grazing is the predominant production system used in Ireland, farmers want to sow varieties suited to animal grazing, therefore a grazing sub-index was established and included in the PPI. Investigations into variety grazing efficiency were conducted in plot trials. Plots were grazed by dairy cows in rotational grazing systems. Within each variety plot, some pre-grazing measurements were made. Post-grazing height measured on each plot using a rising plate meter. The Residual Grazed Height concept was developed to accurately account for grazing efficiency differences between varieties. Increased grazing efficiency was correlated with higher levels of leaf, crude protein and organic matter digestibility. Tetraploid varieties tend to excel in these traits, therefore they were found to have better grazing efficiency than diploids. Selection based on the traits identified in this study will assist plant breeders to select for more grazing efficient varieties. Grazing data from this trial has been included in the PPI as the 'Grazing Utilisation' sub-index in 2021. **This will help the grassland industry and more importantly farmers select better varieties for grazing systems, encouraging grass breeders to increase selections in their breeding programmes for this trait.**

[More information in the slideshow](#)

Improving resilience of organic beef-sheep farming systems

By Claire Mosnier, INRAE - @UMR_Herbivores

Claire Mosnier is an agro-economist working at improving the sustainability of farming systems. She is mainly developing mathematical programming models to investigate the consequences of production decisions on farm production, profitability and resilience, and on environmental impacts, namely on climate change.

Mixed farming systems are gaining interest both as a risk management strategy and to apply agroecological principles. Diversity in organic farming systems is particularly important since those farms have limited access to external inputs and use more frequently direct marketing. The main objective of this study was to identify strategies that improve the resilience and the overall sustainability of organic beef-sheep farms according to farm characteristics and to their short-term flexibility. This study focuses on farms combining beef cattle, sheep for meat and some annual crops. Among the European farms surveyed for the MixEnable project, four French mixed beef-sheep farms were contacted. They were asked what were the main risks they were facing, which variations of yield and prices they considered as being very unfavourable, unfavourable, normal, good and very good and how frequent these variations occurred over the last 10 years. They were asked which levers they usually used to face hazards, namely weather hazards, and which long term adaptations could be considered on their farms. The states of nature of each hazard were crossed assuming independence between risks and considering each farmer declaration. The Orfee bioeconomic farm was used to simulate the impacts of those hazards on farm resilience. The short-term adaptations such as feed purchase, feed stock, modification of grassland use, animal produced and sold and intercropping were optimized by the model for each combination of risk within the range of possibilities specified by farmers. Different long-term adaptations such as the reduction of stocking rate, the modification of the mix of animal species or the increase of annual crops were tested. Farmers had different exposures to risks but all declared a much higher proportion of bad yields than good yields over the last 10 years. Flexibility regarding grassland management and intercropping varies greatly between farmers. Few of them made security stock and most of them prefer buying feed than reducing animal productions. **The simulated results show that optimal strategies vary according to farms but reducing stocking rate and increasing annual and inter crops often appear promising.**

[More information in the slideshow](#)

Does integration promote sustainability in organic multi-species livestock farms

By Marc Benoit, INRAE - @MBenoitBZ

Marc Benoit has been working at INRAE Research Unit on Herbivores (Clermont-Ferrand, France) since 1987. He is an agro-economist; works on the design, modelling and multi-criteria evaluation of livestock farming systems (technical, economic, environmental, feed/food competition), with a particular focus on small ruminants. He has been highly invested in sustainable and organic farming systems for 20 years; and is co-director of INRAE research on organic farming for 7 years.

Implementing agrobiodiversity is a core principle of agro-ecology and organic farming. It is often observed through the lens of crop-livestock integration. However, **keeping two or more livestock species or breeds simultaneously on the same farm is a diversification option that is an option for improving livestock farm sustainability.** Here, we present a pan-European analysis of organic multi-species livestock farms to identify most sustainable management strategies. After characterising the sample of 95 farms combining two or more livestock species (cattle or small ruminants, for meat or milk, pig or poultry), we undertook a partial least square regression analysis to relate sustainability

indicators (productivity, efficiency, human welfare) with indicators reflecting farm structures and management, including the type of marketing and the level of integration among farm enterprises. We show that unlike expectations, the most sustainable farms do not necessarily exhibit the highest levels of integration. We also elaborate on the methodological advances needed for an analysis covering various types of species and productions at the scale of farming system scale. This work is being finalized and has been carried out in the European project MIX-ENABLE provided by transnational funding bodies, being partners of the H2020 ERA net project, CORE Organic Cofund, and the cofund from the European Commission.

[More information in the slideshow](#)

Pulses and oilseed rape for food and feed

By Olaf Sass, Norddeutsche Pflanzenzucht Hans-Georg Lembke KG

Olaf Sass holds a PhD in plant breeding at University of Göttingen in 1988. Since 1988, he has been a practical plant breeder at Norddeutsche Pflanzenzucht (NPZ) in Holtsee, North Germany. Today, he is head of spring oilseed and pulse breeding at NPZ, a privately-owned, medium-sized plant breeding company.

Plant breeding is always driven by breeding goals: as these two crop groups either offer oil and protein (oilseed rape) or starch and protein (pulses), a breeder must make decisions about his priorities. In general the main components are negatively correlated. A too strong selection for one component will reduce the other one. Large seeded pulses like faba beans, peas and lupins for a long time were considered as pure feed components that provide protein and very often also starch thus substituting to a certain percentage of soybean protein/cereals. As soy was cheap and plenty available on the world market, the feed industry in Europe relied on soy imports. Thus, these domestic crops were only marginally grown resulting in low breeding activities and loss of knowledge about their suitability for the main groups of livestock. Due to growing concerns about GM soybean, carbon dioxide footprints and more awareness of locally produced fodder stuff, those pulses have undergone quite a renaissance in the last years. This is continuously supported by exploiting their potential as home-grown food components which is more profitable than being used as feed component. This is enhancing breeding in general and will also potentially fuel research for the feed sector. In oilseed rape, there was a very successful story in breeding for food and feed: eliminating Erucic acid from the oil made the oil perfectly suitable for human consumption. After extracting the oil, the remaining extracted cake contains a high amount of protein with a very good amino acid composition. However, Glucosinolates limited the use of the cake in animal feed. Breeding lowered the Glucosinolate content significantly which makes the residues of oilseed rape extraction well suited as a feed stuff for various livestock species. Farmers in Germany until today are paid a premium for oil content which consequently led to the protein as a component in oilseed rape being of minor importance in Europe. Also, **in oilseed rape we today see a shift to more attention to the protein content: this is driven by a sharp increase in demand for plant proteins, either through direct use for human consumption, or as feed for animal protein production.**

[More information in the slideshow or the video](#)

Panel discussion with speakers and the audience

Moderated by Tommy Boland, University College Dublin and Ana Sofia Santos, FeedInov CoLab & ATF Vice President representing research providers

How to incentivise farmers to move from specialisation to mixed production systems?

Tommy Boland: “There is a problem of economy, all food chains having a vertical organisation, and we need public and market incentives. We also need to change the way we measure performances, including biodiversity, valuing ecosystem services, moving from “more milk per cow” to “global efficiency of the use of biomass”. Changing value chains will take a generation, as none of our agricultural systems are sustainable so far. The next CAP may support a transition.”

Amrit Nanda: “We need systems approaches in production supported by systems approaches in metrics.”

Ruud Tijssens: “The feed industry is very much involved in discussions about the transition of systems. It advocates for few and simple sets of metrics applicable on farm.”

What main changes do you see in the next 10 years in animal nutrition?

Michael Lee: “Improving the sustainability of livestock systems implies moving further away from a single metric being yield in cropping and livestock systems. We now need to look at a broader set of metrics to measure sustainability. For example, we should look at dietary issues in a context of a rise of metabolic syndromes and a protein surplus in consumers (vs a protein deficit in animals). We need to fully acknowledge and improve the role of livestock in circular food systems, promoting the use of coproducts, feeding animals with non-edible food, valorise the ability of livestock to deliver fibres and AAID. We should be careful in balancing metrics, as chasing carbon can have side effects in terms of biodiversity, P pollution.

What can farmers do? How to get them to choose new types of crops more actively?

Max Schulman: “We need a good price and risk management tool at EU level for crop proteins, but also long-term policies, without change in the middle to let farmers adjust. We need to support farmers and the plant breeding sector to breed new crop varieties suitable to the market in quantity and quality.”

Jean-Louis Peyraud: “Work efficiency is crucial from a farmers’ point of view. Mixed farming systems are difficult to manage to reach efficiency at farm level. Their implementation requires exchanges and cooperation between farmers at regional level. Work efficiency increases do not always have positive effects on farmers’ income, so we need to assess the total amount of work and support exchanges between bigger and smaller farms in a territory. **Farm and pedoclimatic diversity in the EU offer a diversity of solutions.**”

Ruud Tijssens: “Farmers do not always gain from efficiency gains. We need long term contracts and a vision for the market. As a feed industry, we have to play a role”.

Amrit Nanda: “The market will drive value chains; we need to distribute revenue in a fair and sustainable way”.

Lisanne Verschuren: “Commercial breeding goals have a role in the efficiency and sustainability of systems”:

Michael Lee: “We have to re-evaluate the role of livestock in agriculture in a holistic manner, considering the delivery of soil health via crop rotations. **Looking at the whole array of livestock species, monogastrics, insects and aquaculture have a fantastic role to play in valorising waste streams.**”

Frank O'Mara: "I would like to see systems rewarding farmers for efficiency gains... The EU Green Deal and the Farm to Fork Strategy have set up challenging sustainability targets."

Looking at R&I gaps, do we have the solutions for 10 years to allow livestock to have a role recognised by citizens in future food systems?

Ruud Tijssens: "We need scientific homework to reach targets in 2050, and the focus should be for regulation to focus on implementation".

Michael Lee: "Knowledge is often not implemented. We need to optimise best practices and support best farmers to support other farmers and the R&I community."

Max Schulman: "Required changes need investment in animal material, crops species. They need time and investment, make sure you find profitability on the farm and in the whole farming sector. Communication to the society on everything that has already been done is not an easy and simple task. It needs to have the whole chain involved. R&I is required to achieve new developments in new technologies."

Tommy Boland: "This is all about having long-term thinking and short-term solutions, around the fact that beyond food, farmers produce ecosystem services".

Going beyond the Feed vs Food competition: crops and animals together to address food and nutrition security (EAAP session #17)

Novel concepts & methodologies to assess the role of livestock farming in sustainable food systems

Novel concepts and methodologies around the assessment of sustainability in livestock farming: One Nutrition

By Ruud Tijssens, FEAC - @FEAC_EU

Ruud Tijssens is board member, former president of FEAC. "Science needs industry. Today, as representative of industry, I'll be providing much more questions than answers".

There is a need to adjust feed efficiency methodologies considering the added value of animals to valorise inedible feed and biomass from marginal land. The One Nutrition concept joins FEAC's ambition about fostering sustainable food systems through increased resource and nutrient efficiency. It aims to deliver to humans the optimal amount and quality of proteins, by allocating the nutrients in the most efficient, complementary and circular way to meet the needs of all living organisms, making use of all living organisms, and using other organisms than we used before (like fungi, yeasts, etc.). This implies research and innovation about nutrient cycles and balance, optimisation of manure management, understanding plants and animals proteins biological value, data sharing... Technologies are required to better optimise nutrient conversion into bioresources (genomic techniques, detoxification technologies, increased digestibility via processing...). There is a lack of metrics for circular agriculture and nutrient efficiency. Today, nearly all feed used in compound feed manufacturing is not suitable for human consumption as they do not meet the minimum quality and standards. **We need to know where the raw material is coming from, preserve the coproducts status to minimise food waste, looking at fertilisers and soils as starting point of the thinking. Recovering nutrients from wastes is an avenue but it raises safety and antinutrients concerns.** We have to look to new food chains, animal manure/by-products cycling. Finally, to implement the One Nutrition concept, we need a methodological framework.

[More information in the slideshow](#)

Adjusting feed conversion ratio methodologies considering the added value of animals to valorise non-consumable fractions of plant products and biomass from marginal lands

By Jean-Louis Peyraud, INRAE & GIS Avenir Elevages - @PeyraudJean & Anne Mottet, FAO - @Anne_Mottet

Anne Mottet is a livestock development officer with the UN Food and Agriculture Organization. She holds a MSc in agronomy and a PhD in Agro-ecosystems and has close to 20 years of experience in supporting policy makers and stakeholders for the transition to sustainable food systems. Jean-Louis Peyraud is Deputy Scientific Director of Agriculture at INRAE.

The speech aims to envisage different scales and metrics around the concept of feed efficiency to lighten some issues around the feed vs food competition. Anne Mottet presented figures at current situation world level, while Jean-Louis Peyraud focused on EU level. New methodologies developed around FCR (Feed Conversion Ratio) take into consideration the proportion of inedible feed and the use of land suitable for food production, as well as the share of animal feeds available for human consumption. They highlight important differences between systems and species in terms of efficiency. **Each livestock system has its own advantages.** Those new concepts require precise estimation on what is edible or not and methodological harmonisation. Coupling livestock and crops may lead to a more efficient agriculture, by increasing the valorisation of co-products and non-usable land for crop production.

Finally, the apparent opposition feed vs food may lead to fully consider the role of livestock in a circular bioeconomy. Livestock is more efficient than often claimed. Ruminants are even more efficient as they make use of cellulosis in grass and they can also produce food from marginal land that cannot be cropped and create environmental services, so they can be net contributors to the global protein supply. Ways forward in R&I reside in the allocation of land (at what opportunity cost?), attributable vs consequential and scenario analysis. For the sake of the limitation of the feed vs food competition, we should prevent expansion of arable land dedicated to feed production, by using dual purpose crops (food first, then feed), improvement of grassland use efficiency, improvement of FCR, encouraging the use of inedible materials.

[More information in the slideshow](#)

Evaluate the land-use efficiency of regional livestock systems from a food systems perspective

By Donagh Hennessy, Teagasc - @teagasc

Donagh Hennessy is a PhD candidate working at Teagasc, studying land-use efficiency and national livestock production in Ireland. This is done as part of the Animal Production Systems Group in Wageningen. They have a BAgSc from University College Dublin and an MSc in CCAFS from the National University of Ireland in Galway.

The aim of this study is to evaluate the land-use efficiency of four different livestock systems from a food systems perspective. To this end, we quantified the land-use ratio (LUR) of livestock systems in seven regions of Ireland across different soil types and climatic conditions. The LUR is a metric that quantifies the level of feed-food competition occurring in livestock systems. It compares the quantity of human digestible protein (HDP) produced by the livestock system against the HDP of the potential alternative crop from the land used to grow the system's feed and fodder. The source of this feed may be in-situ pasture or feed imported from crop systems at a national and international level. A LUR of <1 demonstrates that the livestock system is an efficient user of its land; producing more HDP than could be grown in the alternative crop. In contrast, a LUR of >1 in a livestock system demonstrates that the system is land-use inefficient. The four livestock systems studied include three pasture-based ruminant systems: the dairy and its surplus beef calf system; a suckler beef system, a sheep-meat system, and a monogastric pig system. The different biophysical features in the regions as studied include different pasture yields, different proportion of pasture suitable for crop systems, and different crop yields. In this study, only the dairy beef system had a LUR value <1 in every region; LUR values ranged from 0.21 to 0.71. The sheep-meat system is land-efficient in only three out of seven regions, LUR ranged from 0.52 to 2.16. The suckler beef system was land-efficient in only two out of seven regions, LUR values ranged from 0.77 to 2.78. Lastly, the pig system was not land-use efficient in any region, LUR values ranged from 1.89 to 2.00. Hence, our results demonstrate that **certain regions are more suitable for ruminant systems based on their suitability for cropping and pig systems that were based human edible feed were consistently land-use inefficient.**

[More information in the slideshow](#)

A partial Life Cycle Assessment of smallholder livestock systems in Western Kenya

Phyllis Ndung'u, University of Pretoria - @UPTuks

Phyllis Wanjugu Ndung'u is a Kenyan citizen and a final year Ph.D. student at the Department of Animal and Wildlife Sciences at the University of Pretoria, South Africa, as well as being a graduate fellow at Mazingira Centre at International Livestock Research Institute, Kenya. Her main research interests focus on improving livestock greenhouse gas emissions quantification for accurate accountability of African livestock systems' involvement in climate change.

Ruminants are central to the economic and nutritional life of much of sub-Saharan Africa, but cattle are now blamed for having disproportionately large negative environmental impact through emissions of greenhouse gases. However, the exact mechanism behind these emissions is not well-understood and indeed accurate estimates are lacking due to a paucity of reliable data. Smallholder mixed cropping/livestock are the dominant livestock keeping systems in the highlands of East Africa. Employing individual animal records obtained at regular farm visits, this study quantified farm-level emissions intensities (EIs) of greenhouse gases for smallholder farms in three counties of Western Kenya. Crude protein (CP) was chosen as the functional unit to capture outputs of both milk and meat. The results showed farm EI ranged widely from 20 - >1,000 kg CO₂-eq/kg CP and median EIs were 60, 71 and 90 kg CO₂-eq/kg CP for Nandi, Bomet and Nyando respectively. Enteric CH₄ contributed >95% of emissions and manure ~4%, with negligible emissions attributed to input to the production system. Collecting data from individual animals on smallholder farms enabled the demonstration of an extremely heterogenous EI status amongst ostensibly similar smallholder farms and provides clear indicators on how low EIs may be achieved in these environments. **Contrary to current belief, our data show that industrial- style intensification isn't required to achieve low EI, but that those are associated with more output-oriented smallholder systems.**

[More information in the slideshow or the video](#)

Policy making, environmental, territorial and economic soundness, social acceptability of novel options for reconnecting crops and livestock sector

Restoring or reinventing the virtuous cycle of crop-livestock integration?

By Shirley Tarawali, ILRI/GASL - @ILRI

Shirley Tarawali is Assistant Director General at the International Livestock Research Institute (ILRI) based in Kenya and Chair of the Global Agenda for Sustainable Livestock. Shirley's portfolio includes representation, engagement within ILRI and beyond for livestock and the wider development agenda.

Crop-livestock systems are ubiquitous worldwide, and far more common across the developing world where they provide at over half the cereals, meat and milk as well as supporting livelihoods of about half a billion people. In Europe some 30% of farms are less than 20ha, and often integrated crop-livestock units. As future food systems are contemplated with the multiple challenges of planetary health, human health – or better still, One Health, mitigating waste, addressing environmental

sustainability and so on, the place of these small, integrated farms must be carefully evaluated. **In much of the developing world, the multiple, essential roles of small crop-livestock farms for food and nutrition security, livelihoods, income and much more will need to respond in the context of rapidly rising demand for milk, meat and eggs in particular.** There needs to be transformation without losing the benefits of integration. In Europe, and across much of the developed world, a production system transformation has taken place, with small, mixed farms being replaced by larger but less integrated units – enterprises producing feed, animals, and food are often very separate spatially. And while production may have greater efficiency the downsides of environmental pollution, waste products, animal health and welfare among other challenges have raised concerns leading to a new focus on returning to the smaller integrated crop-livestock farming units. This presentation reviews ongoing work undertaken in the context of the Action Networks of the Global Agenda for Sustainable Livestock along with integrated research solutions from CGIAR and partners targeting transformation of the crop-livestock systems across the developing world. It considers the diverse pathways towards integrated production for future food systems that fully benefit from a circular bioeconomy.

[More information in the slideshow or the video](#)

Panel discussion with speakers and the audience: What are your ideas, suggestions for R&I topics?

With panellists, moderated by Ana Sofia Santos, FeedInov CoLab & ATF Vice President representing research providers, and Michael Lee, Harper Adams University and President of the EAAP Commission on Livestock Farming Systems

About the valorisation of waste streams: do we have skills and expertise to avoid the transmission of diseases?

Ruud Tijssens: “Circulation is the basis of circularity. This is still a priority area for R&I. Processed animal proteins are coming back, under a very strict regulation (cannibalism regulation) which for example does not allow poultry feed to poultry. You have to redesign supply chains with that as an objective.”

According to LCA, are intensive dairy productions more sustainable?

Anne Mottet: “It depends on the metric (FCR or protein) used for the assessment. Other metrics could be considered as well. We should prioritise the restoration of the potential of degraded pastures and optimise feed crop residues. Diversity of production systems is an asset; we do not need to oppose as they all provide options.”

Jean-Louis Peyraud: “High producing dairy cows are efficient if we consider milk. Medium producing cows are better for biodiversity. Very low producing dairy cows may be very efficient when they receive a very small amount of concentrates. There is a win win in the improvement of forage quality through a better understanding of the biology of plants.”

Shirley Tarawali: “The issue of trade-offs is key. We should look at the many other functions of livestock. In many countries, animals are raised to contribute to crop production as a fertiliser. Having a diversity of systems is important. Animal genetics should support the improvement of animal performances, as well as a bundle of technology solutions”.

Donagh Hennessy: “In arable areas, we should strive to develop an agroecological way to produce crops, including forage and intercrops to support soil fertility and brake pest occurrence. This should lead to design the number of ruminants we can feed with these forage crops. Agricultural lands should be in some places removed from livestock systems, replaced by pasture with sustainable crop rotations.”

Phyllis Ndung'u: “We have proposed interventions to improve efficiency in Kenya. We should consider animal health. What would hinder productivity is farmers not being able to supplement with minerals.”

Is the market rewarding farmers and consumers for reconnecting plants and animals and reducing the feed vs food competition?

Ruud Tijssens: “The market is asking for it. We are advocating for developing metrics we can offer to retail including circularity”.

Jean-Louis Peyraud: “Today environmental labelling of food products is based on LCA. It leads to hamper red meat, failing to consider biodiversity. Having robust metrics is important. A labelling approach stimulating for all the food chain. It creates a market for consumers who accept to pay for it. It supports public policies and retail.”

Shirley Tarawali: “Yes, we should recognise the diversity and differences in livestock systems.”

What is the way forward to transition?

Frank O'Mara: “**Ruminants are excellent to valorise marginal land and forage use, while monogastrics are very efficient in converting crop residues. We should really optimise and keep a diversity of systems.**”

Ruud Tijssens: “It is difficult to say a kind of system is not what we want. If you want to steer into a direction, the most efficient is to give it a price. We should make sure everyone is moving towards more biodiversity, less emissions, etc.”

Shirley Tarawali: “We all want sustainable and healthy production systems. Optimisation and diversity are important. How to get there? There may be different solutions across systems to optimise across different dimensions.”

Phyllis Ndung'u: “Not all systems are low input. Farmers need to fully use what they have on their farm. Some systems need to catch up”.

Jean-Louis Peyraud: “We need to maintain different types of systems. Each system has its own solutions... including horses, having small ruminants and grassland in intensive crop areas. In some areas, we need to produce cheap food, develop new systems with ruminants, pigs and forest to address forest fires.”

Ruud Tijssens: “We should take planetary boundaries and solidarity around the globe as a priority”.

Anne Mottet: “It's hard to tell people what to eat.”

Take away messages

Frank O'Mara: “Livestock has a role. It is not simple to assess the food vs feed tension/competition. It depends on species, animals, feed, region, but also the metrics we use, etc. Beyond the feed vs food competition, we should consider attributes like biodiversity, health qualities, livelihood of farmers towards an understanding of the whole sustainability of systems. We should keep a multidimensional framework in evaluating systems. Looking at weak points, we should bring all systems towards more sustainability and resilience. There is a big role for R&I and knowledge exchange to make livestock farming systems more sustainable.”

The next ATF event on the topic will be held on 18 November 2021 in Brussels, as a hybrid conference.