



The feed behind our food

Time to act on feed



Executive Summary

Protein is fundamental to human health, but the way we currently produce and consume it is placing a heavy strain on land and sea resources, our climate and our health.

With the world population projected to reach nine billion by 2040, protein demand is set to rise to levels that cannot be sustained by the existing food system – and, in particular, by the way we currently feed animals.

We believe that retailers and food service companies have a vital role to play, in working with the animal protein and feed industry towards solutions that are both sustainable and commercially viable.





Why take action on animal feed?

First, it's an issue of **food security**, and how we use our precious resources like land. Under the current system, humans compete with animals for the same feed sources, which is unsustainable for a growing population. By 2050, meat production is forecast to grow by nearly 70%, aquaculture by 90% and dairy by 55%¹ – and meeting future demand for animal feed using current feed sources will require an estimated 280 million hectares of additional land by 2030².

Second, **attitudes are changing**. Increased recognition from the public and the food industry about the impact of animal feed production on ecosystems is feeding the demand for more transparency about where our food – and its feed – comes from.

Third, there's a **business opportunity** for companies that take action now to ensure a safe supply of healthy animal feed to meet future demand. It's an opportunity to build trust and brand loyalty.

Future-fit animal feed

Many companies are already making progress towards future-fit animal feed.

A growing number are conscious of supply chain risks, and focus on addressing issues such as deforestation through certification or other tools.

Others are investing in new, innovative feed alternatives that require less land, are more water-efficient and have a smaller greenhouse gas emissions (GHG) footprint – in particular by sourcing alternative proteins such as insects, algae and seaweed.

How to take action

If you are a retail or food service company, the first step is to start collaborating with your supply chain to address challenges and opportunities surrounding animal feed. In this report, we suggest some questions to help begin your conversation with those in your supply chain.

The Protein Challenge group has developed a set of criteria for sustainable feed that is fit for the future, which we'd like your feedback on. This will inform the Feed Compass tool which, when launched, will help you work with your suppliers to promote better animal feed practices.

This guide sets out in more detail how and why you need to act on feed now to secure your business future.

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About Feed Compass

Animal feed is a critical action area identified by the global Protein Challenge 2040 coalition – which explores how we can feed nine billion people enough protein in a way which is affordable, healthy and good for the environment.

The Protein Challenge is the first time that the global animal, plant and novel protein industries are working together with the aim of accelerating progress towards sustainable production and consumption of protein, and helping to scale impactful solutions.

The collaboration is driving a range of projects that tackle the challenges head on, from increasing the proportion of plant-based protein in diets to addressing protein waste and losses.

As part of the Feed Compass project, an ambitious and diverse international group of leading retailers, feed ingredient companies,

innovators and NGOs from across the food system are developing an easy-to-use tool, based on the criteria set out in this document, to help compare different types of feed and guide purchasing decisions.

Our ambition is that the Feed Compass tool will support the food industry in ensuring animals are fed sustainably and help to future-proof our food system in the long term.

To find out more, contact Simon Billing at s.billing@forumforthefuture.org.

“With increasing pressure on global resources, the evolving animal protein market cannot take existing supply chains and raw materials for granted. Change is opportunity, so companies must now reappraise the sustainability of their supply chains and assess feed protein sources.”

ANDY RICHARDSON

HEAD OF CORPORATE AFFAIRS, VOLAC

Members of the Protein Challenge 2040 partnership:



Supported by



Three reasons to act on feed

Based on current yields and feed sources such as soy, meeting future demand for animal feed will require an estimated **280 million hectares** of additional land².

This is an area the combined size of Germany, Poland, UK, Ireland, France, Italy, Spain, Portugal, Belgium, the Netherlands, Switzerland, Austria, Czech Republic and Slovakia.



01

Food security

As global commodities, animal feed sources present a real business and food security issue.

Over the last two decades, approximately 20% of the Earth's vegetated surface has shown persistent declining trends in productivity, driven by multiple factors including intensive agricultural practices³.

Already, the cultivation of livestock and animal feed has dramatically altered landscapes around the world. Nearly half of global agricultural land is used for livestock feed production^{4,5} and despite the well-publicised issue of overfishing, 22% of the capture from fisheries is used for animal feed⁶.

Feed crops are vulnerable to price volatility as the risk of extreme weather events gets more acute⁷.

Ensuring supply will become more difficult with increasing demand, limited scope for agricultural expansion and dwindling natural resources⁸.

Any business with an eye to the future needs to be examining their supply chain and planning how to ensure its long term viability.

02

Changing attitudes

The general public and the food industry are starting to recognise that how we produce animal feed drastically affects the health of our ecosystems.

This, in turn, is feeding the demand for more transparency about where our food – and its feed – comes from^{9,10}.

Greater transparency about the sustainability of feed crops helps build trust with consumers. Progressive companies that act on feed will be better positioned to create this trust.

This will become more important against the backdrop of escalating competition for land, continued degradation of ecosystems and increased vulnerability, especially of the poor¹¹.

03

The business opportunity

A major innovation drive is needed to ensure a safe supply of healthy animal feed to meet current and future demand.

There are many commercial benefits: there is the ‘first mover’ opportunity, alongside the ability to spread your risk portfolio should any feed crop sectors struggle in the years ahead.

Sourcing alternative animal feeds that are less dependent on land, water and at-risk species also helps to shorten supply chains, making them more resilient. Any alternative feed also needs to be nutritious and consistent with high standards of animal welfare, with reduced mortality and antibiotic usage being desirable.

Offering more sustainable and transparent products provides more opportunities to build trust and brand loyalty. And for this, customers are often willing to pay a premium¹².

Retail and food service companies now have the opportunity to set industry expectations, demonstrate leadership and work with industry to create new and exciting products. Doing so will help you build trust with an increasingly savvy general public, build your reputation as an ethical business with excellent commercial foresight, and ensure your future business viability.



The impacts of **animal feed**

Competition for land

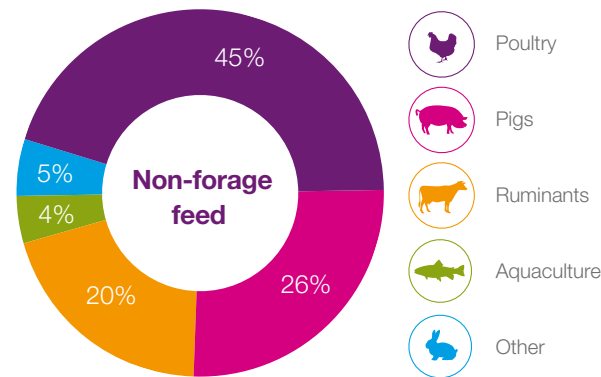
The production of global feed requires 2.5 billion hectares (ha) of land (including 2 billion ha of grassland), which equates to about half of the global agricultural area⁴ – and demand for land for feed production and grazing is projected to continue increasing.

Animal production requires more land per calorie or unit of protein than plant-based equivalents¹³.

Most ruminant (cattle, sheep, goats) production systems use primarily feed resources – grass, other forages and fibrous plant by-products – that are not edible by humans. Often this feed is grown on land unsuitable for food crops, such as grassland in upland regions.

Monogastric animals, such as pigs and poultry, eat many protein sources that could be consumed by people, grown on land that could be used for food crops. For example, of the global area devoted to cereal production, 31% is growing cereal grain for livestock⁴.

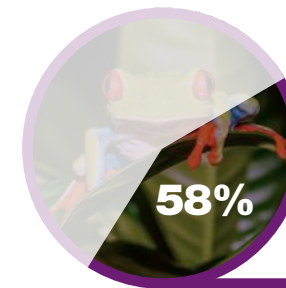
Manufactured feed market as a percentage by species¹⁴



Globally, poultry consume the greatest amount of manufactured feed.

Deforestation and biodiversity loss

The world's net cultivated area has grown by 12% over the last 50 years, mostly at the expense of forest, wetland and grassland habitats¹⁵, which provide benefits such as regulating water quality, carbon storage and biodiversity. With limited options for agricultural expansion, future feeds must increase land efficiency and help to address biodiversity loss, a pressing global issue.



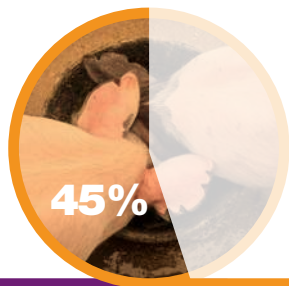
Global populations of fish, birds, mammals, and other vertebrates declined by 58% between 1970 and 2012¹⁶.

Feed production uses about **half** of global agricultural land.



Greenhouse gas emissions

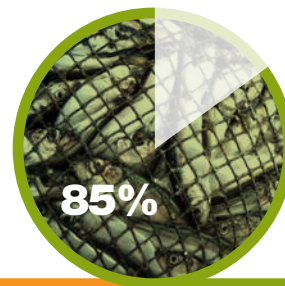
The livestock industry is responsible for 14.5% of global greenhouse gas (GHG) emissions¹⁷. 45% of livestock GHG emissions are caused by feed production and processing. Energy consumption and land-use change are two major causes of these emissions¹⁸ and vary significantly by region¹⁹.



45% of livestock GHG emissions are caused by feed production and processing.

Overfishing

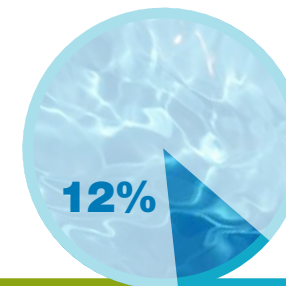
Since 1961, the global demand for fish has risen at twice the rate of the world's population²⁰. Today, nearly 85% of global fish stocks are either exploited or, even worse, depleted²¹ – which itself contributes to climate change²². Approximately 22% of wild fish capture goes towards animal feed²³.



85% of global fish stocks are either exploited or depleted.

Water impacts

Of the total water consumption in animal production, 98% is associated with the feed crops²⁴. The irrigation of feed crops consumes 12% of the global groundwater and surface water²⁵. In many countries, water management in agriculture is depleting groundwater aquifers and reducing water quality²⁶.



Feed crops use 12% of global groundwater and surface water for irrigation.

14.5% of global greenhouse gas emissions are from the livestock industry.



“ It will be very challenging to meet the future demands for livestock and farmed fish products in sustainable ways without undergoing a huge transformation in the way we produce animal feed. ”

SANDRA VIJN DIRECTOR, MARKETS AND FOOD, WORLD WILDLIFE FUND (WWF US)

Criteria for sustainable animal feed

In 2016, we surveyed 62 global industry stakeholders to better understand the challenges and solutions in scaling up feed innovation²⁷.

One clear request was for shared sustainability standards that would allow food and feed companies to compare one option with another, and so make informed choices.

These criteria and definitions form our first attempt to outline the qualities of a sustainable animal feed that's fit for the future.

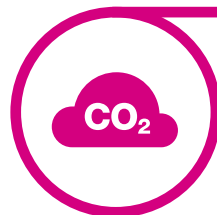
These feed criteria are still open for review. We invite engagement and collaboration with relevant companies, groups and individual stakeholders.

To share any feedback, contact Simon Billing at s.billing@forumforthefuture.org



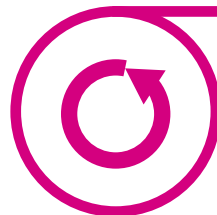
Restorative land use and biodiversity practices

The feed requires a minimal land footprint²⁸ with suppliers not contributing to conversion of high-value ecological land. Any land management practices will build soil health, and seek to increase biodiversity²⁹.



Minimises greenhouse gas emissions

The feed should have a dramatically reduced GHG footprint in comparison to the industry average. GHG footprints are conducted using Life Cycle Analysis assessments. The GFLI are developing a publicly available tool to support this¹⁹.



Takes a 'circular' approach

Where possible, the feed will make use of crops (e.g. forages) and co-products from food production that are inedible by humans.



Minimises pollution

The feed minimises air and water course pollution (i.e. eutrophication, acidification). Inefficient application and overuse²⁹ of fertilisers have caused major damage to the environment, particularly in water pollution, soil erosion and causing harm to human health³⁰.



Minimises freshwater consumption

The water footprint of the feed should be measured and minimised through efficient operations³², so that reserves are not depleted and water for humans is prioritised.



Minimises fish stock depletion

Feed production does not contribute to the depletion or exploitation of fisheries.



Promotes animal health and nutrition

High quality animal feed supports the health and wellbeing of the animal – and healthy animals have less need of antibiotic therapy.



Supports human rights and welfare

All workers involved in the feed supply chain receive high standards of labour welfare and respect of human rights³². The feed supply chain is vast and includes farm labourers and factory workers. In some regions, working conditions can be dangerous and poorly paid.



Financially viable

Animal feed needs to be financially viable for both feed producers and livestock farmers. This is one of the main challenges for new, alternative feeds as they undergo commercialisation.

How to take **action**

There are two key stages through which companies can speed up progress on sustainable animal feed.

01

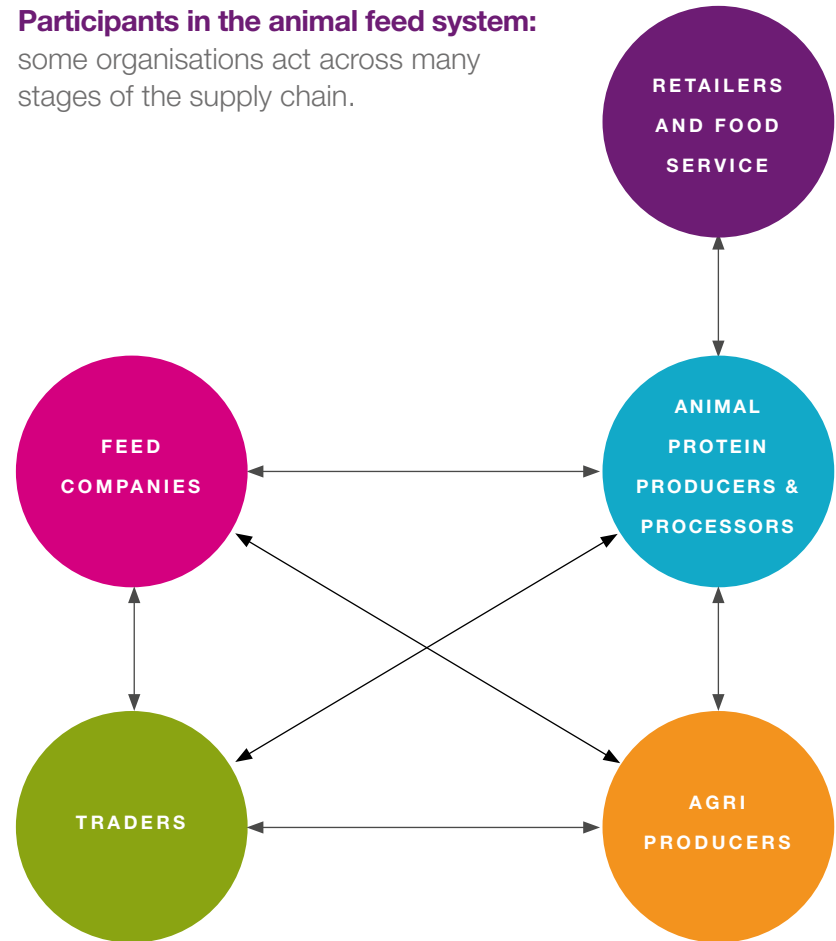
Building knowledge through research and honest dialogue with your supply chain about animal feed ingredients.

02

Building a strategy by setting goals and developing a strategy that includes your innovation needs, and identifying potential collaboration partners.



Participants in the animal feed system:
some organisations act across many stages of the supply chain.



01

Building knowledge

Building knowledge about feed security and sustainability is critical to moving forward on this issue. Asking the right questions to the right stakeholders can help identify risks and increase transparency through the supply chain.

The following questions are designed to kick start a conversation as a guide to get you started:



Questions for your business

- What are the most important categories and products we sell for which animal feed is a relevant issue?
- Who are the internal and external stakeholders we need to be engaging?
- What is our relationship like with first tier suppliers?
- How can I work with my supply chain to encourage the use of more sustainable raw materials?

Questions for your direct suppliers (or tier 1 suppliers)

These are some of the questions to start a conversation with the suppliers who raise livestock and fish.



- What is fed to the animals you raise? And in what volumes?
- How do you track and manage the origin of your feed ingredients?
- What are your key decision making factors in purchasing animal feed?
- What understanding do you have of the footprint of the feeds used?
e.g. GHG emissions, eutrophication, acidification, water pollution
- What sustainability standards or certifications are being used in accordance with the feed?
e.g. RSPO for palm oil; IFFO RS, MSC or ASC for marine; RTRS for soy.
- What other requirements have you set for your suppliers?
e.g. zero deforestation, working conditions, antibiotic use
- What are the key opportunities and barriers for exploring more sustainable options?
- Have you taken any action to explore the use of innovative protein sources or feed formulations?



02

Building a strategy

Taking action on animal feed will require you to:



Set goals

Host or join conversations with producers and feed companies to explore the market signals and set goals.

This can drive innovation as suppliers have the permission and incentives to pursue new initiatives.

Having goals and a timeline also enables you to better articulate your future expectations for animal feed to suppliers.

Goals are more robust if they are aligned with the risks you've identified, as well as relevant sustainability frameworks, such as the Sustainable Development Goals.

Create an action plan

A strategy and action plan will provide the roadmap towards meeting your goals.

This may involve areas for R&D, marketing opportunities, product trials and setting new business standards, and should be embedded into business planning cycles.

Some questions to ask:

- What sustainability standard(s) can you work towards to demonstrate your commitment to a more sustainable supply chain?
- How can you give customers greater transparency?
- What are the marketing opportunities for customers and the wider industry? For example, are there specific products that demonstrate animal feed innovation that you can share?

Identify collaboration partners

Map out the organisations you need to collaborate with to accelerate progress towards your goals and catalyse industry-wide change.

Some may already sit within your existing network; others may be new partners. They may include investors to drive commercialisation opportunities for new animal feeds.

Shaping **future-fit** animal feed

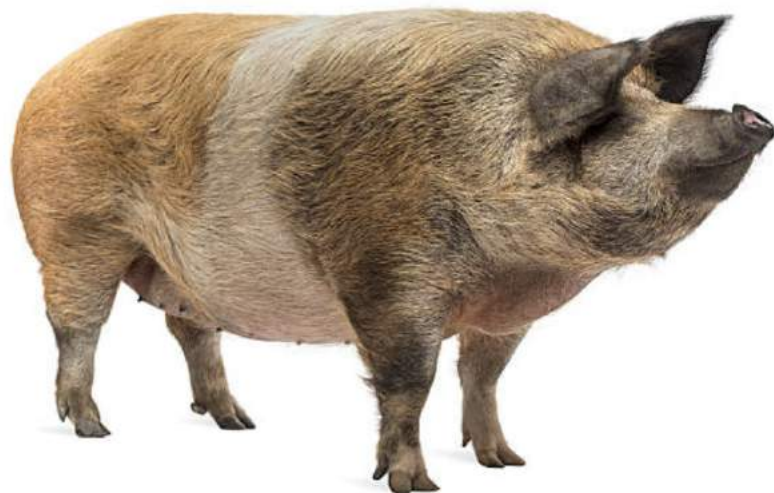
Many companies are in pursuit of future-fit animal feeds. While there's no silver bullet solution, this section aims to help you make sense of what's emerging to help inform your strategy.

Solutions tend to fall into two categories: those that improve current practice, and those that create new innovative solutions. Some innovations are already on the market, whilst others are in the process of commercialising or testing.

We encourage you to engage with your suppliers and stakeholders to explore whether these innovations could work for your supply chain, and if yes, how and when.

“ We are seeing **increased investor activity** in animal feed alternatives – not just angel, seed and VC investments, but also large strategic and institutional players. Investments are ranging from just a few hundred thousand, all the way up to hundreds of millions.”

MIKE VELINGS FOUNDER, MANAGING PARTNER,
AQUA-SPARK



Improving current practice



Many retailers and food service companies are focusing on improving existing agricultural practices – for instance by pursuing greater resource efficiency, reducing pollution and reducing land expansion. This includes:

Responsible sourcing: improving supply chain transparency, traceability, and strengthening procurement policies and decisions. For example: commitments to halt deforestation and promote local sourcing.

Better practices with existing crops: integrating more sustainable practices into the crop production and land management.

Crop diversification: to support biodiversity, climate resilience and soil fertility (i.e. more legumes).



How Waitrose is improving the sustainability of its animal feed

Waitrose is working towards procuring 100% of soy in their supply chain from sustainable, certified sources, and so far they have achieved 77% of their target.

The retailer is also working to improve supply chain security by sourcing animal feed from raw materials grown within the UK and Europe. In 2016, soy grown in the Danube region of Europe began to be used as a source of protein in pig feed by the retailer's dedicated pork supplier.

Furthermore, Waitrose has been engaged in the collaborative 'Sustainable Forage Protein' project, a 5-year initiative that brought together eight of Waitrose's commercial farms, researchers and processors to improve the capability of UK protein production from forages – thus reducing dependency on imported soy protein. This project saw producers substituting soy based feeds for crops such as protein-rich chicory, lucerne and red and white clover grown on their own farms. They are also trialling fava beans as a long-term soy replacement for chicken, pigs, ducks and salmon.



Responsible sourcing

Responsible sourcing of high risk ingredients like soy has been an integral part of many retail and food service sourcing strategies for years.

For more details of standards for different inputs, consult the International Trade Centre standards map: www.sustainabilitymap.org.



Adjusting agricultural practice

This can also improve the sustainability outcomes of crop production. For example:

- Cover crops to reduce fertiliser loss
- Measures to protect, maintain, and restore natural buffers to absorb runoff
- Improved fertiliser application practices such as the 4R method (right type, place, time, rate)
- Precision application of crop inputs such as irrigation and nutrients
- Landscape-scale planning to improve the integration of production with wildlife and other ecosystem services.



Diversifying feed crop rotations and alternatives to soy

Almost 80% of soy produced worldwide is used as livestock feed, with much of it being cultivated in Latin America, placing its rainforests and other high value landscapes at risk.

Various soy substitutes exist that can support more local production, such as rapeseed meal, legumes and lucerne.

Rotating corn and soy with other crops such as oats, wheat, barley, rye or triticale, can help reduce the use of fertilisers and herbicides, while improving soil health and productivity.

Innovative solutions



These solutions tend to require significantly less land, are more water-efficient and have a reduced GHG footprint. This includes:

Sourcing alternative proteins such as insects, algae, seaweed, bacteria and yeast derived protein.

Speciality feed supplements: adding amino acids and enzymes increases the digestibility of proteins in plants, reduces the total amount of crops required and minimises nitrogen and phosphorus losses.

Closing the loop: crop production and the food supply chain produce large amounts of residues, co- and by-products which constitute nearly 30% of global livestock feed intake⁴. Solutions of this type are not covered in this guide, yet have an important role in sustainable feeds.



Sourcing alternative proteins

Insects are part of the primal diet for many animals, including pigs, poultry and fish. They contain many valuable nutrients including protein and lipids. It is expected they will become a common, reliable alternative or addition to protein sources for aquaculture and livestock.

Single cell proteins that form the basis for feed can be created using bacteria that metabolise methane. At least two companies, Calysta and Unibio, are now scaling up their feed production facilities.

Algae is increasingly considered a key solution. Several species of algae contain high levels of omega-3 and essential amino acids, making them ideal replacements for fishmeal³³. Research also demonstrates a high protein yield per unit area^{34,35}. Regulation is still in its infancy and some technical advances are still required to bring solutions to the mass market.



Using insects to reduce mortality and antibiotic use

Insect company **Protix** produces insect oils for use in poultry and piglet feeds, replacing the need for ingredients such as soybean oil and palm kernel oil.

An external trial conducted by Coppens Diervoeding showed favourable performance in terms of end weight and feed conversion ratios (FCR)³⁶.

The insect oil also contains 40% lauric acid, which is known for its antimicrobial and antiviral properties. It is thought that this makes the animals healthier, reducing mortality rates and reducing the need for antibiotics.

Insect oil is classed as an animal fat; therefore it is allowed for use in all animal feeds under EU legislation.



Ynsect

Ynsect uses insects to convert low-value organic substrates unsuitable for human consumption, such as cereal by-products, into sustainable and healthy proteins that can form a part of premium animal feed.

The company is currently focused on mealworm larvae for the fish feed and pet food markets. Early tests found that substituting 100% of fishmeal in fish feed with mealworm protein meal showed a 34% increase in body weight in rainbow trouts and white shrimps, a 5% decrease in salmon mortality and a 40% decrease in shrimp mortality.

In the last three years, Ynsect has raised US\$37 million in investment and is currently building a new large facility with an initial capacity of 20,000 tonnes per year, with capacity to double or triple in the next phase. Against a backdrop of increasing fishmeal prices, Ynsect is positioned to offer commercially viable premium feed ingredients.

Changing legislation on insects: Globally, there is limited specific legislation on the use of insects as feed ingredients³⁷. In the EU, as a result of the BSE outbreak in the early 1990s, legislation was put in place that prevented farmed insects from being used as feed for livestock. In July 2017, new amendments to EU legislation authorised certain insect proteins for use as feed in aquaculture. While it's still not possible to feed poultry and pigs with insect-based feed, this may change following positive trial results.



Calysta FeedKind®

Calysta is a California based biotech company that works with methanotrophic bacteria, a type of bacteria that metabolize methane in the same way that yeast eat sugar. This process creates a product that is naturally rich in protein, which can be used to make animal feed.

Calysta's FeedKind protein feed ingredients are based on this methane-sourced protein. It has shown promising pre-biotic benefits, including helping animals to maintain a healthy gut and immune system. A trial conducted by Texas A&M University found that low level inclusions of FeedKind protein in shrimp diets could dramatically improve growth and survival, while a separate study with Pontus Aqua in rainbow trout showed up to 10% improvements in feed conversion ratios as compared to a fishmeal-based feed. Additionally, a [Carbon Trust report](#) found that FeedKind uses 77-98% less water compared to more common feed ingredients, such as soy, rapeseed and wheat³⁸.

Calysta currently operates a demonstration facility in Teesside, England that is producing trial samples, and has partnered with Cargill to scale up production. Its first plant in Memphis, USA, will have an initial capacity of 20,000 tonnes per year, with the option to expand up to ten times in the next phase.



New plant to manufacture marine algal oil: a fish oil replacement

DSM and Evonik are investing US\$200 million to build a manufacturing plant in the US that produces marine algal oil: an industry first. It will be an alternative to fish oil, with nutritional qualities well-suited for use in aquaculture – mainly for fat-rich species such as salmon. Other uses for land-based livestock are also being pursued.

Worldwide fish oil production is approximately 1m metric tonnes per year and the aquaculture sector currently uses about 75% of this. This new plant will meet 15% of the current demand for EPA and DHA, two key nutritional qualities present in fish oil. The algal oil is approved for use in the EU and tests show that it is as digestible as fish oil. Evonik estimate that 1kg of algal oil can replace 60kg of wild caught fish.





Speciality feed supplements

By supplementing feed with amino acids, it's possible to reduce the amount of plant-based protein required, such as soybean meal. Adding supplements to help modulate gut health (such as probiotics) is also shown to help with antibiotic reduction efforts^{39,40}.

Studies are showing how this kind of supplementation substantially reduces the global warming, eutrophication and acidification impacts of feed. For pigs and broiler chickens, GHG emissions have been shown to reduce by about 55% in Europe, 16% in North America and 26% in South America, compared to feed formulas without amino acids⁴¹.

Another study showed that supplement feeds in swine reduced acidification and eutrophication by up to 29% and 19% respectively⁴², as a result of improved digestibility.



Amino acids in focus: their potential for animal and planetary health

The application of amino acids is already common practice all over the world. However Evonik believe their full potential is not yet realised: 'If the content of amino acids in the feed is not optimal, animals excrete some of the feed without digesting it. As a result, the yield of precious agricultural land is wasted. If we increase the proportion of protein in animal feed by adding soy or fish meal, it places an additional burden on crop land or fish stocks. The targeted addition of amino acids could prevent this.'

Amino acids also enable farmers to use more locally-produced crops or co-products from food production; thus avoiding the mass importation of proteins like soybean meal from formerly biodiverse regions which have been extensively cultivated for animal feed.

Conclusion

The data and projections make it clear: animal feed is a defining issue for the food sector, now and into the future.

As we have outlined in this report, for companies that take action now, the potential for positive impact is huge. There is a great opportunity to go beyond risk management and build more resilient supply chains – whilst supporting both animal and human health, limiting environmental damage and enhancing your brand story.

As ever with sustainability issues, the right approach will never be one-size-fits-all. Each company needs to examine its own operations closely, work out where it can have the most meaningful impact and take steps forward.

What's clear is the critical role of collaboration. This is a complex issue that no single organisation can solve alone. By working in

cooperation with industry peers and the feed industry, we have a much better chance of achieving change at scale.

We also invite you to get in touch with the Feed Compass project to explore how it can support you on this agenda. And look out for the Feed Compass tool, which we hope will make sense of the many interacting factors involved in defining sustainable animal feed.

By tackling this challenge together, we have the opportunity to create a brighter future where animal products are more sustainable.

To help shape Feed Compass, or find out more about this initiative, contact Simon Billing at s.billing@forumforthefuture.org.

“Retailers and food service companies need to work hand in hand with feed producers and animal protein producers to really achieve a step-change towards a sustainable feed-to-food value chain. **The Feed Compass** is critical in helping the entire sector reach a shared vision for what a feed fit for the future needs to deliver.”

THOMAS KAUFMANN SVP SUSTAINABILITY DEVELOPMENT, NUTRITION & CARE, EVONIK

Further reading and resources

For a deeper understanding of the issues that drive The Protein Challenge 2040, take a look at The Protein Challenge Summary Report.

All About Feed: online and print publication on the animal feed manufacturing industry.

Aquaculture Stewardship Council (ASC): is developing a standard to minimise the key negative environmental and social impacts of the production of the main feed ingredients for aquaculture. This standard is set to be implemented in the existing certification scheme.

EU Product Environmental Footprint pilots: EU collaborative initiative to develop processes for measuring the life cycle environmental performance of products including feed.

Feedipedia: an open access information system on animal feed resources that provides information on nature, occurrence, chemical composition, nutritional value and safe use of nearly 1,400 livestock feeds.

Feed Navigator: trade news portal for the animal feed and animal nutrition sector.

Global Feed LCA Institute (GFLI): an important industry initiative that aims to develop a free and publicly available feed LCA database and tool, primarily for feed companies.

Livestock Environmental Assessment and Performance Partnership (LEAP): a multi-stakeholder initiative led by the UN Food and Agriculture Organisation that has developed guidelines for measurement of the environmental impact of animal feed.

The Futures Centre survey on animal feeds: a global industry stakeholder survey in 2016 to better understand the challenges and solutions in scaling feed innovation.

“Today’s consumers value sustainable practices and transparency, and they expect retailers and food service to act as gatekeepers on their behalf. The entire industry looks to these companies for direction on quality and sustainability.”

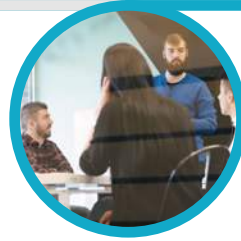
LYNSEY WENGER CFO AND CHIEF SUSTAINABILITY OFFICER, CALYSTA



Feed Compass and The Protein Challenge 2040

Animal feed is one of six critical action areas chosen by **The Protein Challenge 2040** group – a global cross-industry coalition which sets out to explore how we feed nine billion people enough protein in a way that is affordable, healthy and good for the environment.

We are looking for more ambitious and pioneering collaborators to help us make animal feed more sustainable and achieve a better protein system.



Help us navigate the way forward

Demonstrate leadership and innovation while influencing the growing dialogue on sustainable feed. Joining the Feed Compass advisory group gives you the opportunity to build relationships with others who are working on this issue, and will help you foster greater collaboration with your value chain.



Develop the Feed Compass tool with us

We are looking for progressive retailers, food service companies, animal protein producers and feed companies to join us in helping lead the development of the Feed Compass tool. This will help others choose the right mix of animal feed, which will address many sustainability issues.



To get involved or find out more, contact **Simon Billing** on s.billing@forumforthefuture.org.

Visit our **Futures Centre** to keep track of trends, key insights and opportunities for the protein sector.

With **thanks**

We would like to thank the members of the Protein Challenge group who have led this workstream, and the many experts who have contributed their knowledge and expertise to this project in the last 12 months.



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References

1. Alexandratos, N. and Bruinsma, J. (2012). World agriculture towards 2030/2050: The 2012 revision. *ESA Working paper No. 12-03*. FAO, Rome.
2. Wirsenius, S. et al. (2010). How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? *Agricultural Systems*, 103, 621-638. doi:10.1016/j.agsy.2010.07.005.
3. United Nations Convention to Combat Desertification (2017). *The Global Land Outlook*, first edition. Bonn, Germany.
4. Mottet, A. et al. (2017). Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Global Food Security* 14, 1-8.
5. FAOSTAT (2016). Available at: www.fao.org/faostat/en/#data
6. FAO (2016), *FAO Yearbook: Fishery and Aquaculture Statistics 2014*. FAO, Rome. Available at: www.fao.org/fishery/publications/yearbooks/en
7. FAO (2012). *Price volatility from a global perspective: Technical background document for the high-level event on: Food price volatility and the role of speculation*. FAO headquarters, Rome, 6 July 2012.
8. For an overview of the 'drivers of change' that present substantial challenges to food security, refer to: Foresight (2011). *The Future of Food and Farming*. Final Project Report. The Government Office for Science, London.
9. The Center for Food Integrity (2015). A clear view of transparency and how it builds consumer trust. *2015 Consumer Trust Research*. Available at: www.foodintegrity.org
10. Kenward, E. (2016). 'Clean Supreme' leads top trends for 2017. *Food Ingredients First*. Available at: <http://bit.ly/2fvNUNV>
11. IPCC (2014), *Climate Change 2014: Impacts, adaptation, and vulnerability. Chapter 13: Livelihoods and poverty*. Cambridge University Press, Cambridge, United Kingdom and New York. Available at: <http://www.ipcc.ch/report/ar5/wg2>
12. Label Insight (2016). *Driving long-term trust and loyalty through transparency*. Available at: www.labelinsight.com/hubfs/2016_Transparency_ROI_Study_Label_Insight.pdf
13. UNEP (2009). *Towards sustainable production and use of resources: Assessing biofuels*. United Nations Environment Programme, Division of Technology Industry and Economics. Paris, France.
14. IFIF (2017). *International Feed Industry Federation: Annual Report 2016/17*. Available at: <http://annualreport.ifif.org>
15. FAO (2011). *The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk*. Food and Agricultural Organisation of the United Nations, Rome and Earthscan, London.
16. WWF (2016), *Living Planet Report 2016: risk and resilience in a new era*. WWF International, Gland, Switzerland.
17. Gerber, P.J. et al. (2013). *Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities*. FAO, Rome.
18. Garnett, T. et al. (2017). Grazed and confused? Ruminating on cattle, grazing systems, methane, nitrous oxide, the soil carbon sequestration question. *Food Climate Research Network, University of Oxford*. Available at: www.fcrn.org.uk
19. The Global Feed LCA Institute (GFLI) is developing an LCA database and tool to support environmental footprinting of animal feeds: including GHG emissions, various pollutants and water impacts. The tool and database will allow regions to benchmark their current LCA value, identify priorities for improvement and measure the impact of these improvements.

This is an important step forward for the environmental footprinting of livestock products and complements the work of Feed Compass. For more information visit: globalfeedlca.org.
20. FAO (2011). *Review of the state of world marine fishery resources*. FAO, Rome.
21. Ibid
22. Harball, E. (2014). How fish cool off global warming. *Scientific American*. Available at: www.scientificamerican.com/article/how-fish-cool-off-global-warming
23. FAO (2016), *FAO Yearbook: Fishery and Aquaculture Statistics 2014*. FAO, Rome. Available at: www.fao.org/fishery/publications/yearbooks/en
24. Mekonnen, M. M., Hoekstra, A. Y. (2012). A Global Assessment of the Water Footprint of Farm Animal Products. *Ecosystems* 15(3), 401–415.
25. Ibid
26. FAO (2011). *The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk*. Food and Agricultural Organisation of the United Nations, Rome and Earthscan, London.
27. Forum for the Future (2017), *The food behind our food: Poll results: The future of animal feed*. Available at: www.thefuturescentre.org/articles/11015/which-animal-feeds-are-fit-future
28. Recommended reading related to land use efficiency in livestock systems:
 - van Zanten H. et al. (2015). Global food security: Land use efficiency of livestock systems. *The International Journal of Life Cycle Assessment* 21:747-758. doi: 10.1007/s11367-015-0944-1.
 - Garnett T. (2009). Livestock-related greenhouse gas emissions: Impacts and options for policy makers. *Environmental Science and Technology* 12(4):491–503.
 - Eisler M.C. et al. (2014). Steps to sustainable livestock. *Nature* 507:32–34.
29. Recommended reading on the characteristics and outcomes of different agricultural systems: IPES-Food (2016). From uniformity to diversity. *International Panel of Experts on Sustainable Food systems*. Available at: www.ipes-food.org/reports.

30. For a relevant study concerning drivers and potential for pesticide reduction, refer to:

Lechenet, M. et al. (2017). Reducing pesticide use while preserving crop productivity and profitability. *Nature Plants* 3, 17008 (2017) doi:10.1038/nplants.2017.8.

31. For an example of the environmental damage caused by excessive fertiliser application, refer to:

Ju X. et al. (2009). Reducing environmental risk by improving N management in intensive Chinese agricultural systems. *Proceedings of the National Academy of Sciences of the United States of America*. 106(9), 3041-3046. doi: 10.1073/pnas.0902655106.

32. The LEAP (Livestock Environmental Assessment and Performance) Partnership is a multi-stakeholder initiative that is committed to improving the environmental performance of livestock supply chains, whilst ensuring its economic and social viability. For more information: www.fao.org/partnerships/leap.

33. For further information, the European Algae Biomass Association represents both research and industry in the field of algae technologies.

34. van der Weide, R et al. (2015). *Opportunities of Algae as Ingredient for Animal Feed*. Presentation. 3N Eco-innovations from Biomass, Papenburg, June 18, 2015.

35. Spruijt, J et al. (2016). *Opportunities for micro algae as ingredient in animal diets*. Application Centre for Renewable Resources. Available at: <http://bit.ly/2yXXTpY>

36. The Feed Conversion Ratio (FCR) is the amount of feed an animal requires to gain a kilogram of body weight. The lower the FCR, the more efficient an animal is in retaining the protein and energy from the feed.

37. van Huis, A. et al (2013). *Edible insects: Future prospects for food and feed security*. FAO, Rome. Available at: www.fao.org/docrep/018/i3253e/i3253e.pdf

38. Carbon Trust (2016). *Assessment of environmental impact of FeedKind™ protein*. Available at: www.carbontrust.com/media/672719/calysta-feedkind.pdf.

39. Allen, H. et al. (2014). Finding alternatives to antibiotics. *Annals of the New York Academy of Sciences*, 1323: 91–100. doi:10.1111/nyas.12468.

40. Hume M. (2011). Historic perspective: Prebiotics, probiotics, and other alternatives to antibiotics. *Poultry Science* 90 (11): 2663–9. doi:10.3382/ps.2010-01030

41. Kebreab, E. et al. (2016). Environmental impact of using specialty feed ingredients in swine and poultry production: A life cycle assessment. *Journal of Animal Science*, 94(6), 2664-2681. doi: 10.2527/jas2015-9036.

42. Garcia-Launay, F. et al. (2014). Evaluation of the environmental implications of the incorporation of feed-use amino acids in pig production using Life Cycle Assessment. *Livestock Science* 161, 158-175. doi: <http://dx.doi.org/10.1016/j.livsci.2013.11.027>.





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