



Feed of the Future: Transparent and Traceable

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Creating an ESG screen to address animal feed sourcing risk

Agriculture produces around a third of greenhouse gas (GHG) emissions globally, but while the news is rife with information around emissions related to beef and food waste, there exists a surprising secret around animal protein, both terrestrial and aquatic: most livestock and aquaculture producers do not know most of the specific practices and sources associated with ingredients for feed that their animals consume. And they also don't know where or how they were all produced. This challenge goes beyond GHG emissions, as not knowing the origin and production system involved in feed ingredients could mean they were produced with slavery, deforestation and conversion, or illegal, unreported, and unregulated (IUU) fishing, among other risks inherent in sourcing a variety of global commodities and feed ingredients.

This isn't for lack of interest; rather, most feed companies hold their proprietary formulations close to the chest. So while buyers of animal feed are able to obtain key nutritional information, such as protein and amino acid content, to ensure the health and optimal nutrition requirements for the animals, they usually don't

get a breakdown (or at least not a complete one) of what ingredients are in the feed, in which proportion, where they are from, or how they were produced.

There are reasons for this information gap. Animal feed¹ companies (including aquaculture feed) have complex supply chains, which draw on a variety of agricultural byproducts and coproducts that might otherwise be landfilled. Feed companies rarely buy directly from the original source producer, and there may be up to six tiers of suppliers of by-products, co-products, and other derivatives, depending on what is being sourced. They have developed complex algorithms to create formulations based on type of animal, stage of growth, and economic, nutritional, and environmental factors, to name a few. This is because feed companies are asked by their customers for specific nutrients, proteins, oils, amino acids, etc., but the companies primarily rely on least cost formulation to meet these needs. Because of this, they often substitute the cheapest ingredient source at the time of manufacture, taking into account global production levels and costs.

With climate change, ingredient variability and substitution within rations may become even more common. As a result, it is imperative that feed companies know and are able to provide information regarding the substitutes that they use, as changes in feed matrices can impact palatability, processes, and animal response/productivity. Because of this level of complexity within animal feed, the productive needs of animals are well studied, due in part to the research and development done by the feed industry and producers of animal protein. That might help to explain why feed companies are protective of their formulas.

Given that it is difficult to trace the origin of the animal protein products that humans eat, it is no wonder that tracing animal feed, which includes many ingredients (some complex ration products may contain 50-75 ingredients, though companies may be sourcing up to 100-200 or more different items across products) presents challenges. Animal feed can include ingredients of fairly low economic value, as well as those that are mixed at processing plants of a common product, such as soy, or that involve different species, such as reduction fisheries or trimmings mixed prior to or after processing. Beyond traceability and environmental considerations, there are additional concerns about labor conditions for reduction fisheries as well as for trimmings from tuna and other species. Furthermore, there is growing momentum for companies that buy animal feed or animal products to increase visibility into, understanding of, and accountability for their Scope 3 emissions, including the embedded impacts of feed ingredients, as well as to understand risk across their supply chains. They can't do this without having a better grasp on where all the ingredients in their feed are coming from and how they were produced.



With awareness about the causes and impacts of climate change, every stage in the food production supply chain is facing increased accountability requirements to reduce GHG emissions, mitigate climate impact, protect nature, and prevent human rights violations, among other critical sustainability measures. This is especially important for animal feed given the potential for embedded emissions resulting from deforestation and conversion of habitat, which represents an elevated risk for soy, in particular, but for other feed ingredients (e.g. palm oil or palm kernel cake) as well. Additionally, current and developing legal requirements will make animal protein companies liable for actions that others take in their supply chains. Marine ingredients such as trimmings and bycatch carry their own unique and prevalent risks, such as overfishing and human rights abuses, including slavery. The range of potential emissions across production systems, regions, and whether risks such as deforestation and conversion are embedded can influence a product's emissions considerably, sometimes resulting in 10-to-100-fold differences. **Table 1** (below) offers a few examples of the potential differences.

Table 1: Examples of GHG footprint differences from farming and deforestation practices (tons CO₂e)²

	Oil palm fruit	Soybean	Beef
Typical footprint on farm (excluding land use change)	0.5	0.7	57
Sample range of emissions within a country (excluding land use change) ³	0.4 – 0.7	0.2 – 1.2	28 – 65
Footprint from deforestation (added to range above if applicable)	1.8	9.6	525

From GHG to ESG

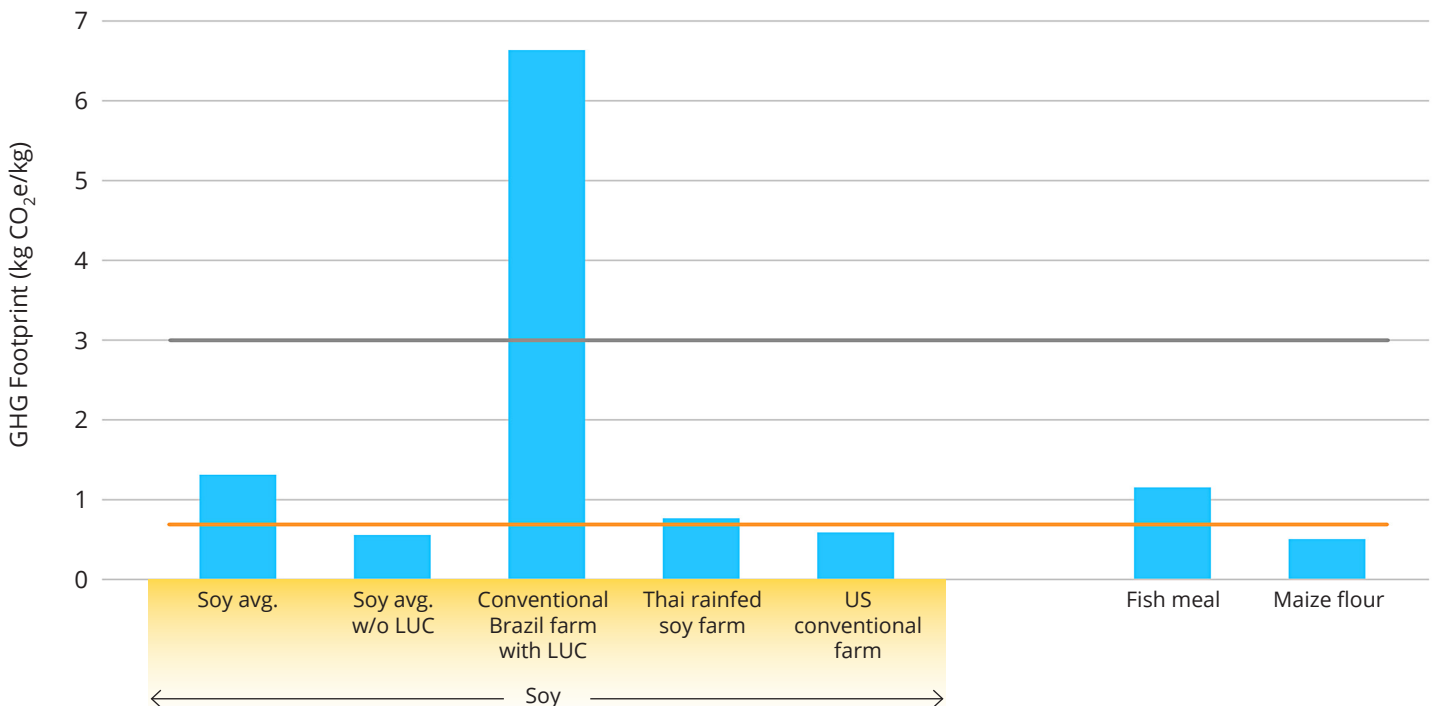
Beyond the accountability required for company commitments to reduce GHG emissions, including Science Based Targets (SBTs), regulations are beginning to catch up to environmental, social, and governance (ESG) risks within the agriculture sector. The US Securities and Exchange Commission (SEC), for example, recently proposed to enhance disclosures regarding ESG investment practices, although recent reporting indicates that the SEC is considering softening the planned rules due to company pressure.^{4,5} The European Union taxonomy for sustainable activities will also lead to increased pressure for disclosure.⁶ The taxonomy is a classification system for environmentally sustainable economic activities; the system considers deforestation, water use, and many other climate metrics.

ESG assessments can be useful barometers of risks that enable companies to home in on where they need to focus risk mitigation efforts, whether that be

human rights and labor risks, environmental risks such as deforestation and conversion, or others. However, an issue with current ESG analyses is that there is considerable variability in how ESG scores are assessed, what metrics are used, and how (if at all) they can be compared across companies and ratings providers. Right now, company to company comparisons are not apples to apples, and it is difficult to understand how to navigate the complexity.

For animal feed, which is complex on its own, these challenges are compounded. Where ESG and other sustainability analyses rely on self-reported company data, there can also be challenges or questions around objectivity.⁷ Furthermore, many of the metrics in current ESG assessments rely on default emissions factors created from averages across regions or production practices to estimate GHG emissions. As seen in **Table 1** (page #2), with such wide variability based on production system, geographies, deforestation, and other factors,

Figure 1: Example of hypothetical feed ingredients relative to the GHG screen criteria. For this screen element, the question is “What is the GHG footprint for the ingredient? Must use Product Environmental Footprint (PEF) and economic allocation.” Any ingredient with a footprint less than the orange line would be flagged as “low” risk, while any above the grey line are “high”; those in between are “medium.” Note that this screen can be used both to distinguish which categories of feed (e.g., fish meal vs. maize flour) might be higher risk or which sourcing regions or practices for one ingredient present different risk (e.g., soy). Soy values are calculated from Poore & Nemecek 2018; fish meal and maize flour are from Agrifootprint 5.0. While there are variances in emissions depending on the type of fish meal, this represents an average across potential fish meal varieties.





using averages to assess risk is inadequate and can lead to masking the impact of bottom performers.

Additionally, there is an important role for ESG analysis in the environmental space. Science-based targets are a useful tool for companies to create commitments and track progress against them over time. Certifications for individual ingredients, such as Round Table on Responsible Soy (RTRS) Certified, also provide value, but certifications take time and are not necessarily a viable solution at scale across global markets. ESG analysis has the benefit of being more agile, especially when conducted within a company's own supply chain, and is able to respond to changing risks, allowing for quicker assessments of where a company stands on a variety of factors. This is not an either/or; it's a both/and. We need short- and long-term goals for GHG emissions reduction (such as those created through the SBTi) and addressing other supply chain challenges, and we also need the agile risk assessment that is possible from ESG analysis. But for both, the food sector needs to continue to make progress to keep up with the changing climate and the risks it poses.

To address some of these challenges, World Wildlife Fund (WWF) has been collaborating with Grieg Seafood and the Global Salmon Initiative (GSI) to create a business-to-business (B2B) (supplier to farmer) ESG screen for feed ingredients to assess salmon aquaculture's ESG risk from its feed. The tool also has the potential to support companies in making sourcing decisions based on holistic footprint data. Proactively addressing the challenges within the animal feed industry prior to regulation — such as that proposed by the SEC and already in place via the EU taxonomy — becoming formalized puts Grieg Seafood and other GSI members implementing the tool in a position to lead the sector in a new direction that enhances transparency in the aquaculture feed supply chain and increases the understanding of and ability to address feed related risks in the supply chain. With additional requirements pending for the Task Force on Climate-Related Financial Disclosures (TCFD) and the Task Force on Nature-Related Financial Disclosures (TNFD), tools such as the screen will allow Grieg Seafood, GSI members, and others to get ahead of these requirements, rather than having to address them reactively. If more companies seek to

understand the risks embedded in their feed, progress towards mitigating them can be made more quickly and effectively.

Navigating opacity in the animal feed industry

The global animal feed industry, like much of global agribusiness, is relatively consolidated, with a handful of large companies making up the bulk of the industry and many smaller local companies working in specific countries/regions, some even with singular ingredient category focus. When more animal protein companies, such as Grieg Seafood and other GSI members, work together to encourage greater transparency within their feed supply chains, it can help accelerate feed company sustainability progress, making it the norm rather than the exception. The tool will offer better scores for ingredients where data is provided to demonstrate low risk. Conversely, in areas where feed companies or their suppliers are unwilling to share data, or where they do not yet have information, the corresponding ESG scores for their feed ingredients will be low, as components with no data will receive the lowest possible score. Similarly, when feed companies do not know the embedded ingredients in the ingredients they buy, most commonly used GHG and ESG calculations require them to assume the worst, e.g. the highest levels from a specific country or source.

When more companies in a given industry like aquaculture begin to use the ESG tool, this increases the likelihood that they will encourage or even require some or all of their feed suppliers to improve their ESG scores as possible risks are flagged or areas for improvement are identified. As more buyers in the sector become more aware of areas with lower scores, this will likely incentivize improvements and innovations to increase the scores, thereby reducing the associated risk.

In order to create the ESG screen for feed ingredients, WWF and Grieg Seafood worked closely with Grieg Seafood's feed suppliers to address the opacity of feed ingredient formulations. Without knowing the composition of the feed, it is impossible to know the ESG risks that may be embedded within it. This process involved navigating complex non-disclosure agreements (NDAs) across a variety of stakeholders so that the

appropriate feed information could be gathered while maintaining confidentiality. With greater adoption of the tool, the legal process can become more streamlined and straightforward, particularly since the feed industry is fairly consolidated, so many of the feed suppliers who already have NDAs will likely be the same across buyers of animal feed interested in using the tool. Grieg Seafood worked directly with its suppliers on what information was required for the ESG screen, but even the willing suppliers remained cautious. Working with a few key feed companies to encourage greater transparency in sourcing risks can open more doors for greater collaboration across supply chains to mitigate common risks that affect a diverse set of stakeholders.

After gaining insight across suppliers regarding feed ingredient makeup and origin, WWF and Grieg Seafood learned that 10 ingredients make up the vast majority of feed volume.⁸ But even for that small number of ingredients, there are many different suppliers,

Figure 2.

Assessment topics for ESG screen

1. Transparency
2. Restorative land use and biodiversity practices
3. Climate footprint
4. Circularity
5. Pollution
6. Fisheries
7. Water consumption
8. Fish health and nutrition
9. Human nutrition and health
10. Basic human rights
11. Climate change impacts
12. Governance
13. Scalability





production practices, and geographical differences. Therefore, four ingredients were chosen for the initial ESG screen methodology in order to assess results and gain additional input from the feed companies to further refine the methodology. **Figure 2** outlines some of the areas that were assessed across the various ingredients.

Developing and applying the tool

WWF and Grieg Seafood developed a first version of the tool (see Appendix, page #10) to standardize the requests made of feed companies and ensure the ability of the buyer to make comparisons across ingredients and their risk profiles. Within risk assessments and other analyses of climate impact, a significant challenge is that many stakeholders make slightly different requests for information. While each buyer has their own way of requesting information, varied requests are extremely cumbersome for feed companies and producers. They take valuable time away from company and producer businesses and other activities that could contribute to mitigating ESG risk. Additionally, non-standardized requests for information can lead to differing risk assessments, making it difficult to compare risk across ingredients and suppliers. As such, a goal of the ESG screen is to build consensus to consolidate and standardize asks both to provide each buyer with an apples-to-apples comparison across ingredients and companies, as well as to streamline the amount and type

of information being requested.⁹ This has the potential to provide stakeholders with sufficient knowledge to make holistic decisions linked to their ESG priorities. To achieve progress at the fastest possible speed, all companies across all animal feed value chains, would need to push the same ask for data up the supply chain

WWF and Grieg Seafood tested the tool with three suppliers to get a sense for what information was available, as well as to begin to understand more deeply the risks of certain feed ingredients. One of the most significant challenges encountered was the lack of data availability. This raises the question: how can companies assess risk if data is not available? Where data is not available, companies often include default emissions factors based on average data across production systems and regions, which can provide a barometer for potential risk but doesn't accurately detail risks in a given company's supply chain. If there is deforestation or conversion, companies are still responsible for it even if the precise calculations were not included because the information was not available or was not included. To attempt to address some of these challenges, the tool specifies not only which data should be included, but also the preferred ways to calculate data based on accounting standards, or to select the most appropriate default data should a company not have precise data on its supply chain. These guidelines provide critical context to ensure the tool can accurately assess risks.

One possible result from greater application of the ESG screen could be to encourage suppliers to gather more, and more appropriate, data on risk assessment and/or become more comfortable sharing data they have gathered with their customers but previously kept confidential when their peers do so as well. It is also the case that gaps in data availability make reporting on risk a challenge and, by collectively raising these issues, solutions for generating the best data sets to monitor risk can be essentially crowdsourced.

Applying the tool has proven what we already knew: feed can be a black box, and it can be impossible to assess the risks if you don't know where your ingredients are coming from or how they are produced. However, some risks are simply hard to evaluate. For example, there's growing interest in understanding the soil carbon or organic matter levels on farms, but assessing it is difficult and there are differences in methodologies, if it's being considered at all. Similarly, there is much discussion around food/feed competition – namely, are we feeding human-grade food to animals? But getting a distinction on what is fit for human consumption, how it should be considered relative to animal nutrition priorities, and other factors, is not black and white. Nor is all the data available. Developing the ESG screen raised these and many more issues for consideration, ranging from fishery management (for aquaculture feed using trimmings) to governance to human rights. For example, should some country origins be rated yellow or red just based on recent reports of fraud, corruption, co-mingling of product or labor violations? There are no clear answers, and the tool will continue to evolve as data and understanding of issues with gray areas, such as soil organic matter, matures, and as new and currently unidentified risks rise to the foreground.

After an initial test of the tool, it was further refined to broaden the number of ingredients assessed to nine, edit, add, or remove several assessment factors, and weigh existing factors in a more balanced way according to potential risk. As seen in **Table 1** (page #2), the overall risk profile for feed ingredients can vary significantly depending on where the ingredients are sourced, as well as methods of production or fishing practices. As a greater understanding of ingredient risk is developed, the

tool will continue to be refined in collaboration with WWF, GSI, Grieg Seafood, other protein producers, and feed manufacturers to support further ESG improvements in the supply chain. An encouraging development in this process is that the Aquaculture Stewardship Council (ASC), with the intent to incorporate the ESG screen as one of its due diligence mechanisms to be used as part of the ASC Feed Standard certification process. While this has not yet been finalized, inclusion within the ASC demonstrates the importance of tools like the ESG screen to enhance visibility into challenges within sustainable production.

Some fish feed companies in GSI, such as Skretting, have been endorsing and advocating for use of the ESG tool. This encouraging development has the potential to influence action from other feed companies.

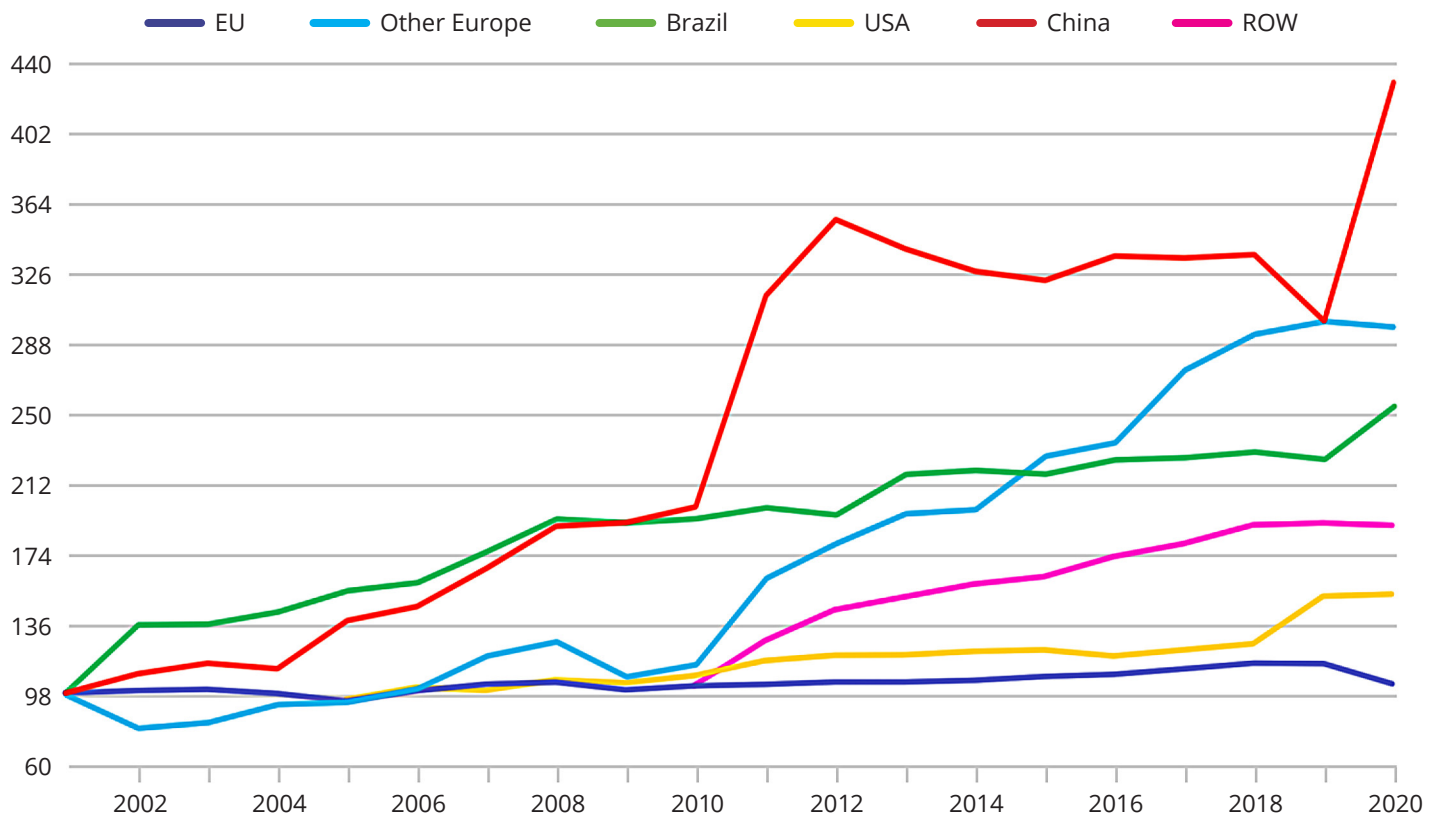
While no feed sector or company data will be shared within GSI, the intention is that through the global alignment on methodology it will help streamline and focus efforts from the feed sector on where to improve traceability in the supply chain. Additionally, the tool can be updated annually based on experience gained from using the tool, further increasing its usefulness over time.

Next steps in tool development

The ultimate goal for the ESG screen is to upgrade from an Excel spreadsheet to a cloud-based platform to host the tool, which will decrease the potential for human error as well as streamline completing the information request to reduce burden and redundancies for feed manufacturers. Specific company data and formulations will be accessible only to those who provide data or others linked in their supply chains who need the information in order to assess the risk. Transitioning to the cloud will enable the tool's methodology to be public, transparent, and predictable. Companies can then report on feed risks they have discovered as a result of the data collection on an aggregated level.

Neither WWF nor GSI will be the ultimate owner of the tool. There has been collective intent from the start that for this work to have substantial impact it must go beyond salmon aquaculture. Simply put, aquaculture

Figure 3: Evolution of global compound feed production (Index 100 = 1999)



Source: FEFAC – Alltech – Feed International

alone does not have the leverage to influence many of the major feed ingredients in the way that other animal protein producers can. So, while Grieg Seafood, GSI, and WWF have been constructing the tool, outreach has been occurring in the shrimp, tilapia, and pangasius sectors, as well as the swine and poultry industries. While there are more supporters of the tool within these other sectors, many producers have also expressed interest in engaging their retail clients. There are retailers interested in the tool as well, but it is critical for them that the tool addresses risks of all animal proteins. To address this need, engagement with other aquaculture sectors and other animal protein sectors will be occurring simultaneously and in partnership with retailers.

Broader implications

Given Grieg Seafood and GSI companies' business, the development of this tool focused on the salmon industry, but the implications go far beyond seafood.

Annually, some 1 billion tons of animal feed are produced and fed to animals, representing a \$400 billion¹⁰ market globally. Feed for salmon aquaculture only accounts for a minor volume of animal feed globally. Businesses including feed companies, farmers, animal protein producers, processors, retailers, restaurants, investors and banks across the value chain, and more are involved – they all have feed and feed ingredients in their supply chains.

Working toward greater transparency in the feed industry is simultaneously everyone's problem and no one's problem, making progress difficult. Because feed is one of many components contributing to GHG emissions across many products, many feed companies are hesitant to be transparent about addressing ESG risks. Some feed suppliers have questioned whether the competition rules allow their customers/farmers to discuss common methodologies for assessing the quality of feed. However, competition authorities (including the European Commission) have begun to recognize that



competitors can in fact work together if joint action is required to achieve climate goals. The ESG methodology will be used by the individual farmers to make individual assessments of their feed suppliers; a commitment to use the tool does not extend to the business decision that a farmer will make after having made an ESG assessment.

In this context, it is challenging for a single company on its own to garner enough influence over the industry to force the issue. This is precisely why a commitment to apply an ESG screen for feed ingredients has the potential to be transformative. In the poultry industry, for example, feed represents around 75% of GHG emissions from cradle to retail. The salmon industry isn't far off from that, with feed representing approximately 70% of emissions. However, if there is soy from Brazil, it can represent 15% of the feed's weight, and if it is not

deforestation free, there can be 60% more embedded emissions in the salmon. If animal protein industries are serious about reducing GHG emissions in their supply chains, addressing feed's impact is critical.¹¹ And they can do more together than they can individually to motivate the feed sector toward change.

The ESG screen also has the potential to be pivotal for assessing risks tied to livestock raised in Europe. Deforestation and conversion risk is low in the region, but it is potentially high for feed ingredients sourced outside of Europe. With the EU and UK enacting more stringent laws regarding deforestation-free sourcing, companies will be forced to act quickly to address issues in their supply chains. Tools such as the ESG screen can enable companies to identify risks in their own supply chains proactively rather than reactively after supply chain disruptions and enable each

company to focus on improvement strategies to meet ESG goals and requirements.

Animal feed ingredient secrecy is coming to an end, and now is the time for feed companies, animal protein producers, and animal protein purchasers to address feed impacts in their supply chains. Given the variability of emissions and other impacts across

regions and production practices, a commitment to using the ESG tool will drive greater traceability and transparency within supply chains — much more quickly and at a more significant scale than working alone. Precompetitive collaboration works, as we have seen through GSI's work driving industry-wide uptake of the ASC standard; now is the time to make it work to increase transparency in animal feed.¹²

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Appendix: Questions Included in ESG Screen

(Please note the below table is a snapshot of questions included in the ESG Screen, but does not represent the full methodology or breadth of the tool)

Category	Question
Transparency	Is the supply chain structure of the feed ingredient transparent?
Management System	Does the ingredient supplier have systems in place to manage the traceability of its supply chain?
Management System	Does the ingredient supplier regularly risk assess its raw materials and suppliers, and categorize into high, medium, or low risk according to company policies?
Management System	If the raw material of an ingredient is identified as medium or high risk, does the ingredient supplier complete an independent audit regularly?
Governance	Are there known issues of illegality associated with the ingredient supplier?
Governance	What is the effectiveness of the origin country's governance?
Governance	Are there known incidences of the ingredient supplier manipulating the ingredient to increase revenue, i.e., dilution, fillers, etc.?
Governance	Are there known incidences where indigenous or local communities have been harmed by the production of the raw material of an ingredient?
Governance	Does the ingredient supplier have a company policy which states it will not source ingredients obtained through illegal fishing?
Governance	Does the ingredient supplier have a company policy which states it will not source ingredients derived from plant primary raw material which has been produced in violation of land use or environmental laws?
Governance	Does the ingredient supplier have a company policy which states it will comply with water usage regulations in region of origin?
Governance	Does the ingredient supplier have a company policy which states it will prohibit the use of pesticides banned by the World Health Organization or the Food & Drug Administration?
Basic Human Rights	Does the ingredient supplier, on a bi-annual basis, collect and monitor the labor and human rights policies of all current and new actors in the supply chain of the ingredients used in our feed?
Basic Human Rights	Does the ingredient supplier have a policy abolishing child labor, forced, bonded, compulsory labor, human trafficking, and discrimination?
Basic Human Rights	Does the ingredient supplier have policies that prohibit charging migrant workers recruitment fees, regardless of proportion of migrant labor that makes up the work force?

Appendix: Questions Included in ESG Screen

Category	Question
Basic Human Rights	Is a grievance mechanism in place for workers in the supply chain of the ingredient?
Basic Human Rights	Is a process of remediation established and corrective actions implemented should human rights violations be found?
Basic Human Rights	Are known incidents of the ingredient provider abusing labor and human rights of workers reported to proper authorities?
Basic Human Rights	Does the ingredient supplier have a policy ensuring gender and minority equality?
Basic Human Rights	Does the ingredient supplier have a policy supporting the freedom of association and the right to collective bargaining?
Basic Human Rights	Have there been incidences when the feed ingredient supplier violated your code of conduct?
Basic Human Rights	Has the feed ingredient supplier self-evaluated performance against your code of conduct?
Basic Human Rights	Does the feed ingredient supplier maintain a code of conduct for its suppliers?
Basic Human Rights	Are the disclosures of your risk assessments of potential human rights breaches connected to this ingredient supplier provided?
Restorative Land Use & Biodiversity Practices	What is the land footprint?
Restorative Land Use & Biodiversity Practices	Are natural ecosystems being converted to produce the raw material of this ingredient?
Restorative Land Use & Biodiversity Practices	Are priority ecosystems being converted to produce the raw material of this ingredient?
Restorative Land Use & Biodiversity Practices	Does the ingredient supplier have a company policy which states it will not source ingredients derived from plant primary raw material which originates from areas resulted from illegal deforestation/conversion?
Restorative Land Use & Biodiversity Practices	Does the ingredient supplier have a company policy which states it will not source ingredients derived from plant primary raw material which originates from areas resulted from legal deforestation/conversion?

Appendix: Questions Included in ESG Screen

Category	Question
Restorative Land Use & Biodiversity Practices	Does the ingredient supplier have a company policy which states it will not pollute surrounding ecosystems from the use of nutrients and fertilizers in its production?
Restorative Land Use & Biodiversity Practices	Has the ingredient supplier made a public commitment/goal to source raw materials free of deforestation?
Fisheries	What is the combined FishSource Score?
Fisheries	What is the lowest FishSource category score for the fishery?
Fisheries	What is the status of improvements in the fishery?
Fisheries	Does the ingredient supplier have a company policy which states it will not source ingredients obtained through unreported or unregulated fishing?
Fisheries	Does the ingredient supplier have a company policy which states it will not source ingredients derived from species that are IUCN endangered or critically endangered species, or that appear in the CITES appendices?
Climate Footprint	What is the GHG footprint for the ingredient? Must use PEF and economic allocation.
Climate Footprint	What is the amount of soil organic content where raw material was produced?
Climate Footprint	What is the trend of soil organic content where raw material was produced?
Circularity	How many co-products are derived from the ingredient's raw material?
Circularity	What is the economic allocation % divided by the mass % of the ingredient to its raw/farm-fresh weight origin? Using EU PEFCR.
Circularity	What is the % of feed ingredient recovered?
Circularity	Is the ingredient suitable for human grade consumption?
Pollution	What is the freshwater water pollution potential of the original raw material?
Pollution	What is the marine/brackish water pollution potential of the original raw material?

Appendix: Questions Included in ESG Screen

Category	Question
Water Consumption	What is the amount of irrigation freshwater used per ton of feed ingredient?
Water Consumption	What is the additional processing/milling water footprint of the raw material of the ingredient (after harvest)?
Water Consumption	What is the freshwater stress of the region where the product is grown?
Water Consumption	What is the freshwater stress of the region where the product is processed? Only applicable if a different region than 10.3
Water Consumption	Does the ingredient supplier engage in mitigation measures to manage water risk?
Fish Health & Nutrition	What is the estimated digestibility factor of the ingredient?
Fish Health & Nutrition	Does it negatively impact organoleptic quality for the fish?
Fish Health & Nutrition	Does the ingredient have mycotoxins and/or antinutritional attributes for the fish?
Fish Health & Nutrition	Does the ingredient contain living organisms?
Fish Health & Nutrition	Does it contain any material from the same species/family as the intended target species?
Fish Health & Nutrition	Has the ingredient shown improved FCR compared with current diet?
Fish Health & Nutrition	Has the ingredient shown improved growth compared with current diet?
Fish Health & Nutrition	Has the ingredient shown improved survival compared to current diet?
Human Nutrition & Health	Can this ingredient cause negative effects for humans?
Human Nutrition & Health	Is the ingredient being used for a positive human health outcome?

Appendix: Questions Included in ESG Screen; Citations/Footnotes

Category	Question
Human Nutrition & Health	Does this ingredient contain plastics?
Climate Change Impacts	What is the risk potential for physical climate risks, such as storms, drought, or other known effects of climate change on the availability of the ingredient?
Climate Change Impacts	Is there the potential for demonstrable carbon taxes to be imposed on the raw material of the ingredient or a co-product?
Scalability	At the current usage rate, will this ingredient remain available?

Citations/Footnotes

- 1 For the purposes of this paper, animal feed and agriculture mentions are inclusive of aquaculture.
- 2 Assuming average 2020 yield from FAOSTAT and carbon content for deforestation from Global Forest Watch, 544tCO₂e/ha: WRI GFW data for 'commodity driven deforestation' average 2001-2015. Amortized over 20 years. Average emissions to farm-gate without LUC from Poore & Nemecek (2018) Science.
- 3 These values are taken from Poore & Nemecek for a single country each; these are for Brazil for soy; Indonesia for oil palm fruit; USA for beef (beef herd). They are for on-farm emissions only, excluding LUC. These are underestimates of full variability, since each data point is often reflective of multiple farms.
- 4 <https://www.sec.gov/news/press-release/2022-92>
- 5 <https://www.wsj.com/articles/sec-considers-easing-climate-disclosure-rules-after-investor-pushback-11675416111>
- 6 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en#what
- 7 <https://www.theguardian.com/environment/2023/mar/30/brazilian-meatpackers-a--sustainability-rating-raises-grade-inflation-concerns>
- 8 The 10 main ingredients were: beans and peas, fish meal, fish oil, guar, rapeseed oil, soybean meal, soy protein concentrate, sunflower, wheat, and wheat gluten.
- 9 Consensus extends only to methodology to strengthen ESG scores and not sharing of assessments across companies.
- 10 <https://ifif.org/global-feed/statistics/>
- 11 <https://www.worldwildlife.org/publications/solutions-to-meet-the-need-for-feed>
- 12 <https://www.worldwildlife.org/publications/the-business-case-for-pre-competitive-collaboration-the-global-salmon-initiative-gsi>