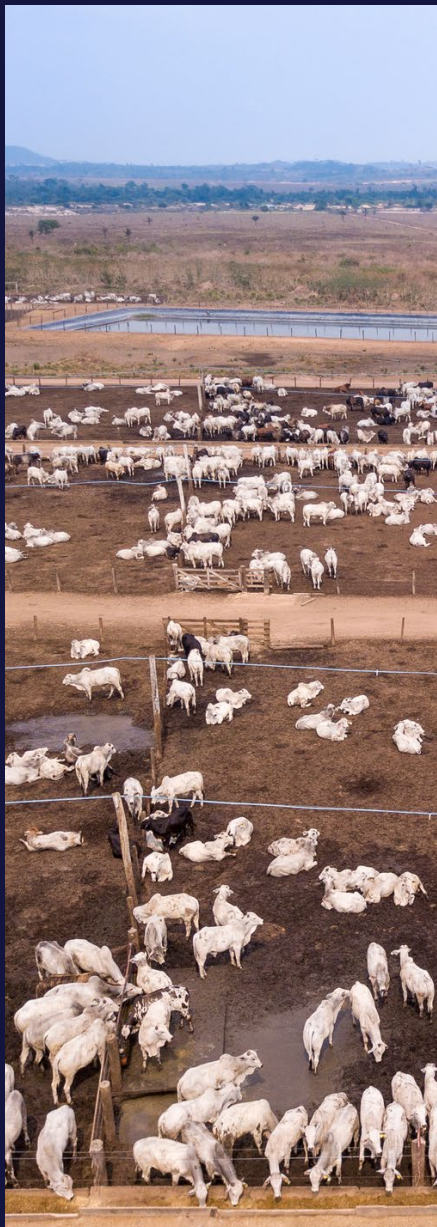


Coller FAIRR Protein Producer Index 2023/24

How the animal protein sector addresses
ESG risks and opportunities

NOVEMBER 2023



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Foreword



Whether it's fitting solar panels, switching to an electric vehicle or supporting political parties that promise stricter environmental regulation, hundreds of millions of people are doing their bit to help us reach net zero.

It's clear that consumers around the world want to reduce their emissions and are changing the way they shop, live and vote accordingly.

Yet all their good work risks being undermined by the international meat and dairy industry – with worrying consequences for investors exposed to the sector

With intensive agriculture creating more greenhouse gas emissions than every car, airplane, train, truck and ship on the planet put together, we've long known that humanity can't fix climate change without fixing the way we feed the world.

So it's extremely disappointing that the sixth annual FAIRR Protein Producer Index shows that the opposite is happening. Among the 20 largest listed meat and dairy firms, disclosed emissions are still rising year-on-year.

Perhaps worst of all, those responsible aren't just rogue outliers: companies that supply household names like McDonald's and Walmart have contributed to an increase of over three per cent in absolute reported emissions over the past 12 months.

Investors should think long and hard about what this means for the risk profile of their portfolios. What choices will consumers make at the till when they discover that their own environmental efforts are being negated by the companies that supply their favourite supermarket or fast food chain?

But as well as revealing the meat and dairy industry's failings – and underlining the urgent need for a real focus on food and agriculture at COP28 – this year's Index also provides cause for optimism.

As a general point, there are fewer companies rated as "high risk" compared to previous years. And even among the worst-performing companies, there have been improvements in areas such as working practices. In addition, the number of companies receiving a coveted "best practice" label on use of antibiotics, while still small, has risen to its highest-ever level.

These positives show that change is possible in this industry. That bad practice is not an inevitable part of the food supply ecosystem. And that when the UN publishes its first-ever net zero roadmap for the sector next month, it will be pushing at a door that is not as securely locked as it once was.

We know that investors will welcome a roadmap as a catalyst for companies, like those featured in this Index, to transition to a more sustainable global food system. Investors expect that, just as the IEA's roadmap for the energy sector helped differentiate the viable assets from the stranded fossil fuel assets of the future, the FAO roadmap could do the same for the food sector.

It's impossible to overstate the importance of the FAIRR Protein Producer Index in driving these improvements. By shining a light on an often secretive industry, it has bridged the knowledge gap among investors and given them solid data and evidence with which they can engage companies on the real business risks and opportunities offered by the transition.

It has also highlighted the enormous risks that some producers face if they don't clean up their act. Because in 2023, they have no excuse for going backwards. Investors, consumers and regulators rightly expect better of the companies that put food on our shelves – and the Index gives investors a valuable tool with which to hold them to account.

Jeremy Coller

Chair and Founder of FAIRR Initiative and Chief Investment Officer at Coller Capital

1. Executive summary

The Collier FAIRR Protein Producer Index: driving positive change

The Collier FAIRR Protein Producer Index was established in 2018 to address the knowledge gap in the environmental, social and governance (ESG) risks associated with the food sector. Recognition of its value has increasingly grown, as has its impact in driving engagement with leading protein producers and supporting investors in the sector.

The Index assesses 60 of the largest listed global meat, dairy and aquaculture companies on ten ESG factors: **greenhouse gas emissions, deforestation and biodiversity, water use and scarcity, waste and pollution, antibiotics, working conditions, animal welfare, food safety, governance and alternative proteins**. Some 50% of companies provided feedback to their assessments this year, demonstrating an encouraging level of engagement as companies actively try to understand their assessments.

It has been a notably busy year for the industry, with various significant environment-related developments shaping the agenda. The publication of the Science Based Target initiative's (SBTi) Forest, Land and Agriculture (FLAG) guidance and the commitment to protect at least 30% of land and seas by 2030 (30 by 30) in the wake of the COP15 Biodiversity Summit have elevated the Index's themes within ESG debates. Media focus has simultaneously kept the spotlight on social risks, such as safe working conditions, freedom of association and fair wages within the industry.

Against this backdrop, there is encouraging evidence of progress.

- Index companies improved by 5% overall this year.
- The only risk factor not to record an increase was antibiotics, which saw a minimal decrease – although seven companies, compared with five last year, now have a Best Practice rating in this category.
- There has been a year-on-year decrease in Index companies rated High Risk – from 55% in 2022 to 45% in 2023 – despite methodology changes that have raised expectations of what constitutes best practice.
- The largest improvements were seen in alternative proteins, waste and pollution and water use.

The gap between the best-performing and worst-performing companies is still growing. The worst-performing companies made limited progress in all but one risk factor.

- The top quartile of companies assessed recorded improvements in every category. However, the gap between the best-performing and worst-performing companies is still growing. The worst-performing companies made limited progress in all but one risk factor, but an overall improvement of 8% in their scores for working conditions is notable.
- No company has yet achieved a Best Practice score across all risk factors, but more companies are securing a Low Risk rating across multiple factors.
- Beef producers saw a notable increase of 11%, largely driven by a rise in governance performance. However, many of these producers also saw a decrease in relation to working conditions.

During the past year, 18 companies have met with FAIRR to develop a better understanding of their performance, and companies continue to use the Index to assess and develop their sustainability strategies.

In tandem, FAIRR's reach as an investor network has grown substantially – from 125 members representing \$US14 trillion in 2019 to more than 390 members representing US\$71.5 trillion in 2023. FAIRR's latest investor survey found 79% of responding members use FAIRR research, including the Index, to inform direct company engagement and 85% use it as part of their sectoral and thematic analyses.

This report focuses on four topics that are increasingly attracting the the most significant interest from stakeholders, including companies, investors and policymakers. These are discussed in brief below.



SBTi FLAG: more accountability for land-intensive companies

Last year's report highlighted the demands of a 1.5°C-aligned pathway, including the need to account for land-based emissions. There is still only limited improvement in this respect, despite pressure for more precise disclosure and looming deadlines for companies to reveal their validated science-based targets.

While there has been a steady year-on-year increase in companies that have validated science-based targets or are committed to setting them, only one Index company – Danone – discloses its FLAG-related targets and emissions. This includes methane emissions disclosure and a zero-deforestation target by 2025. The hope is that more companies will disclose in future reports as SBTi disclosure becomes more widely understood.

In the wake of the Global Methane Pledge announced at COP26, methane emissions disclosure has been increasingly subject to investor scrutiny. With national governments ramping up related regulations, comprehensive disclosure can prepare companies for potential regulatory changes. There has been an increase in the proportion of companies disclosing partial methane emissions – from 18% in 2021 to 28% in 2023 – yet only five companies currently disclose methane emissions as a standalone metric, and only three have targets for methane reduction.

In addition, only two of the 14 Index companies with validated science-based targets have a 2025 deforestation commitment in line with SBTi FLAG guidance. More companies are disclosing targets, but many of these are set for 2030.

While the above points raise concerns about how targets will be disclosed and met, there are elements of mitigation measures that many companies have implemented. For example, more than half of all Index companies now have an alternative protein portfolio – including plant-based, fermentation-enabled and cultivated meat, seafood, eggs and dairy – which contributes to diet shift. Nonetheless, progress on many other measures is still lacking.

As the FLAG sector also has potential for carbon removals, focusing on more regenerative approaches offers another means of contributing to better practices. Although only 20% of Index companies currently discuss ways of promoting improved soil health, there has been progress in this regard. For example, Thai Union has become the first company in Asia to have both a validated science-based target and a zero-deforestation target by 2030. China Mengniu Dairy has also introduced a similar deforestation target. Meanwhile, more companies are providing a full inventory of greenhouse gas (GHG) emissions.

As highlighted by FAIRR's Regenerative Agriculture report, which was published earlier this year, there is still much work to be done to understand how and which regenerative approaches offer the most impactful mitigation. Although regenerative agriculture is a deliberately flexible movement, FAIRR's baseline analysis of the growing number of commitments in the agri-food sector found soil health and carbon reductions and removals (including sequestration) to be the most commonly cited sustainability outcomes.

These outcomes are tightly interconnected. This is because most regenerative practices aimed at improving soil health do so through preserving and building organic matter, which helps store carbon in soils. .

Circularity: going further than footprints

The concept of circularity in the animal protein production industry has emerged as a promising path towards sustainability and resource optimisation. One of its core components involves converting manure and effluents into biogas through anaerobic digestion – a process that not only reduces waste but captures emissions for power generation.

Globally, around 55% of Index companies have embraced this approach. Some choose to sell biogas for additional revenue, while others deploy it within their operations to mitigate emissions and reduce reliance on fossil fuels.

Companies have also found value in repurposing manure and animal by-products by turning them into fertilisers – effectively creating usable resources and reducing carbon footprints. However, such practices highlight the complexity of achieving true circularity, as some resources still find their way outside the system.

Adopting manure as organic fertiliser is essential for circular agriculture, but it is not without risks. Issues such as the spread of antimicrobial resistance (AMR) demand careful consideration. Advanced manure-processing techniques, such as anaerobic fermentation and aerobic composting, offer solutions by mitigating transmission, preserving soil nutrients and generating renewable energy. Companies must prioritise the management of these risks and develop effective nutrient management plans to prevent potential environmental harm.

In addition, the role of feed suppliers in the animal protein production ecosystem cannot be overstated. They are vital in mitigating material risks related to nutrient management in feed farming and alternative feeds. Their investments in sustainable value chains and collaboration with protein producers are critical elements for nurturing circularity in feed production.

Promising trends are emerging in the sphere of nutrient management within feed farming. More organisations are demonstrating a commitment to this area, offering guidance, support and incentives to feed suppliers. These initiatives aim to enhance nutrient management in crop production, encompassing the reduction of fertiliser use and curbing nutrient pollution.

Improvements in how companies approach the issue of water circularity are less evident. Despite the manifest risks associated with water scarcity, 45% of Index companies have not conducted risk assessments to identify processing facilities operating in areas with a medium or high risk of water stress. This poses a concern for investors and hampers the implementation of meaningful action plans.

Numerous companies have initiated efforts to reduce water consumption at their facilities, but only some have set targets for reducing water withdrawals. The number of companies successfully decreasing both consumption and withdrawals remains limited.

Circularity represents a pivotal avenue for enhancing sustainability and resource efficiency in the animal protein production industry. Embracing circular practices, mitigating risks and addressing resource vulnerabilities must therefore be recognised as imperative steps for all companies.

Antibiotics and animal welfare: a vital link

AMR poses a global threat, with a significant proportion of antibiotics used in livestock production – often for non-therapeutic purposes. While some countries have banned the use of antibiotics for growth promotion, routine use for prevention remains common. Stewardship involves phasing out the non-therapeutic use of antibiotics and adopting better animal welfare practices, biosecurity measures, vaccines and responsible treatment protocols.

Various regions, including the European Union (EU) and the UK, are increasingly integrating animal welfare concerns into their AMR action plans. However, some countries, such as China and the US, have plans that do not directly link to animal welfare.

Notably, the EU is leading the charge in revising animal welfare legislation, with a specific focus on housing conditions for various species. Other regions are also taking steps to improve standards, particularly in relation to practices such as gestation crates for sows.

Antibiotics and animal welfare go hand in hand. Companies with stringent antibiotic policies tend to uphold superior animal welfare practices, underlining the need for a holistic evaluation of both aspects. However, only 12% of Index companies currently have a Low Risk rating for both factors – while 42% are considered High Risk in both.



Companies that have sound commitments and measures in place for both these areas are recognised as industry leaders in sustainability and are well-positioned to align with expected regulatory changes.

Investors should therefore adopt a comprehensive approach in assessing risks and opportunities in the protein production sector by considering the interplay between antibiotic stewardship and animal welfare. Companies that prioritise responsible practices benefit from enhanced brand value, consumer loyalty and resilience in a tightening regulatory landscape.

Human capital risks: mounting pressure to demonstrate transparency and equitability

With social risks in this sector increasingly earning the attention of all stakeholders, there is a growing need to assess trends related to human capital management. Companies do not always have a standardised approach to disclosing relevant metrics, meaning direct comparisons can be difficult, but it is nonetheless possible to discern overall shifts and to identify key correlations.

The Index's findings suggest companies with improved injury rates are more likely to disclose improvements in turnover rates. In addition, companies that support freedom of association are more likely to disclose improvements in injury rates. These findings align with the existing literature on the topic and underscore the argument for companies to better manage employee relationships.

Relatedly, the issue of fair wages is becoming increasingly material, not least given its impact on employee wellbeing. Better wages can lead to a more productive workforce, yet the lowest-paid workers – as often found in this sector – have been most negatively affected by recent inflationary pressures.

This year just seven Index companies were found to have directly mentioned a commitment to paying a living wage (defined by the UN Global Compact as one that allows employees and their families to meet their basic needs). Moreover, it is unclear whether this signifies pay above the minimum wage. Some companies use external living wage benchmarks to conduct their fair wage assessments, which is considered a more advanced practice, but the outcomes of these analyses are not always publicly available.

A focus on improving human capital metrics over time can help deliver a variety of meaningful insights into corporate performance. Going forward, it is imperative that companies commit to transparent and equitable human capital management practices that are entirely open to scrutiny and assessment.

Conclusion

The Collier FAIRR Protein Producer Index has come a long way since its inception, evolving into a powerful tool for assessing the ESG performance of major protein producers. Now in its sixth edition, the Index provides unique and granular data for FAIRR's members, acting as the food sector's only comprehensive benchmark. It plays a key role in engaging companies, driving improvements and mobilising investors towards sustainable practices.

The Index has highlighted how regulation, disclosure requirements, public sentiment and consumer practices continue to evolve. Companies must be ready to respond to these factors, and investors must continue to engage in detailed and action-oriented dialogues that help prepare companies for these material changes.

A consistent lesson of the Collier FAIRR Protein Producer Index's findings is that all stakeholders must work collaboratively towards a more sustainable and responsible future for the food sector. The challenges are significant, but the opportunities for positive impact are even greater.

Investors must continue to engage in detailed and action-oriented dialogues that help prepare companies for material changes.

2. Overview

2.1 The Collier FAIRR Protein Producer Index

This is the sixth edition of the Collier FAIRR Protein Producer Index, which assesses 60 of the largest listed global meat, dairy and aquaculture companies on ten environmental, social and governance factors aligned with the United Nations (UN) Sustainable Development Goals. The Index provides financial institutions with best-in-class data, analytics and trends related to the protein sector, helping inform investment decisions and engagement strategies.

60

GLOBAL COMPANIES

10

RISK & OPPORTUNITY FACTORS

37

KPIs

1



GREENHOUSE GAS EMISSIONS

Animal agriculture, responsible for 14.5% of all global anthropogenic greenhouse gas (GHG) emissions, is key to preventing global temperatures rising above 1.5°C.



KPIs

QUALITY OF GHG INVENTORY

SCOPE 1, 2 AND 3 TARGET

EMISSIONS PERFORMANCE

INNOVATION IN GHG EMISSION REDUCTION

CLIMATE-RELATED SCENARIO ANALYSIS

2



DEFORESTATION & BIODIVERSITY

Livestock farming is the single largest driver of deforestation. The loss of critical habitats due to the ongoing intensification of cattle ranching and land-conversion activities are rapidly accelerating the rate of global warming and biodiversity loss.



KPIs

ECOSYSTEM IMPACTS

DEFORESTATION-FREE TARGET - SOY

DEFORESTATION-FREE TARGET - CATTLE

MONITORING, TRACEABILITY AND PERFORMANCE - SOY

MONITORING, TRACEABILITY AND PERFORMANCE - CATTLE

FEED INGREDIENTS & CONVERSION RATIOS

FEED INNOVATION

AQUACULTURE CERTIFICATION

SEA LICE MANAGEMENT

3



WATER USE & SCARCITY

The animal agriculture sector accounts for the use of 30% of all freshwater resources on the planet. The production of animal protein can demand up to six times more of water than the production of plant-based proteins.



KPIs

WATER USE & SCARCITY IN FACILITIES

WATER USE & SCARCITY IN FEED FARMING

WATER USE & SCARCITY IN ANIMAL FARMING

4



WASTE AND POLLUTION

Farming 70 billion animals each year creates localised pollution hotspots. This is often due to improper handling of manure, use of synthetic fertilisers for livestock feeds and poor management of wastewater discharge.



KPIs

WASTEWATER AT FACILITIES

NUTRIENT MANAGEMENT IN AQUACULTURE

MANURE MANAGEMENT IN ANIMAL FARMING

NUTRIENT MANAGEMENT IN FEED FARMING



ANTIBIOTIC USE POLICY

The misuse of antibiotics in livestock is also a significant contributor to growing antimicrobial resistance. Global meat production accounts for 70% of global antibiotic use.

KPIs

POLICY ON ANTIBIOTICS USE

DISCLOSURE OF QUANTITY OF ANTIBIOTICS USED



ANIMAL WELFARE

Farm animal welfare is becoming an increasingly important issue for food companies all along the supply chain. Regulation, consumer awareness, pressure from the media and labelling requirements are all key factors for change.

KPIs

ANIMAL WELFARE POLICY

ASSURANCE & CERTIFICATION

PERFORMANCE ON KEY MATERIAL RISKS

AQUATIC ANIMAL WELFARE

DISEASE MANAGEMENT – FISH

DISEASE MANAGEMENT – SHRIMP



WORKING CONDITIONS

Poor and unsafe working conditions present a major risk to companies within the animal farming sector. Failure to address issues such as human rights and safety of workers can result in serious operational and reputational risks.

KPIs

HUMAN RIGHTS POLICY & DUE DILIGENCE

FAIR WORKING CONDITIONS

SAFETY & TURNOVER DATA

FREEDOM OF ASSOCIATION



FOOD SAFETY

The ability to provide safe, good-quality food is fundamental to the business of food production, and a critical component of efforts to ensure global food security.

KPIs

FOOD SAFETY SYSTEM

PRODUCT RECALLS AND MARKET BANS



SUSTAINABLE GOVERNANCE

Sustainability governance is an all-encompassing factor reflecting awareness of the materiality of ESG risks at executive and oversight levels.

KPI

ASSESSMENT OF A COMPANY'S SUSTAINABLE GOVERNANCE



ALTERNATIVE PROTEINS

Animal protein producers face a range of sustainability risks. Reduced reliance on animal protein sources is key to mitigating operational risks while building agility to respond to market and technological disruptions.

KPI

DIVERSIFICATION OF PRODUCTS TO ALTERNATIVE PROTEIN SOURCES



Drawing on the above, this report explores protein producers' performance through the lens of four key themes: SBTi FLAG; circularity; antibiotics and animal welfare; and human capital risks. In discussing each theme, the report examines the performance of companies and uses case studies to highlight best practice. General trends seen within the themes are also discussed.



2.2 Summary of Index changes

This year's Index features a small number of methodological changes. They are as follows:

- Cattle-specific deforestation or conversion-free targets apply to beef companies only. Dairy companies continue to be assessed like all other companies on deforestation associated with soy feed.
- Aquaculture companies' disease management is now assessed under the animal welfare risk factor.

In addition, five companies have been removed from the Index. They are as follows:

- **Tassal** and **Sanderson Farms** were removed after becoming privately owned. They no longer fit the Index's criteria, since all companies must be public.
- **Fortune Ng Fung Food Hebei** and **Shunxin Agriculture** were removed because their revenues from the animal protein segment were the lowest among Chinese companies. Two Chinese companies with bigger market capitalisation have replaced them..
- **Cherkizovo Group** was removed due to the ongoing political situation in Russia, which has led to widespread divestment.

Five new companies were added as replacements for the above, taking into consideration, among other factors, the protein mix of the Index, the exposure of FAIRR's investor members and regional representation. They are as follows:

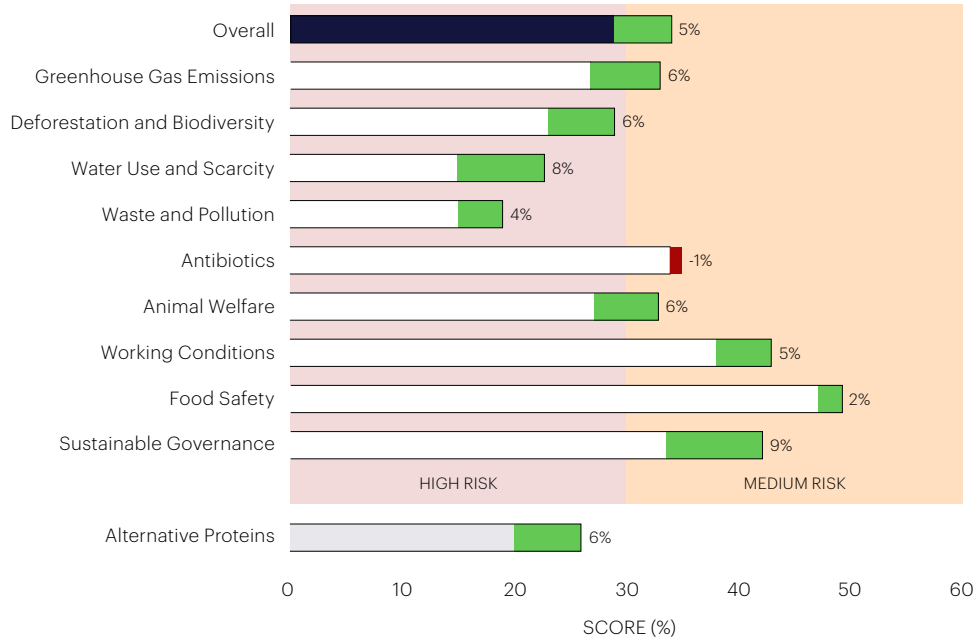
- **Danone**, **Saputo** and **Want Want China** are all dairy companies. While the dairy sector is responsible for 44% of protein revenue, the dairy market accounted for only 9% of the 2022 Index – hence the decision to include more dairy companies..
- **Itoham Yonekyu** is the second-largest pork producer in Japan and complements the existing Asian pork companies in the Index.
- **Guangdong Haid** is one of the largest food and agriculture companies in China. Predominantly an animal feed producer, it derives 10% of its revenue from animal farming.

2.3 Company ranking and key findings

Index companies improved by 5% overall this year. The only risk factor not to record an improvement was antibiotics, which saw a minimal decrease – although seven companies, compared with five last year, now have a Best Practice rating for this category. The largest improvements were seen in alternative proteins, waste and pollution and water use. The 8% rise in performance on water use and scarcity is especially welcome, given that there had previously been no improvement since 2019 – although this factor remains tied with waste and pollution in terms of poor performance.

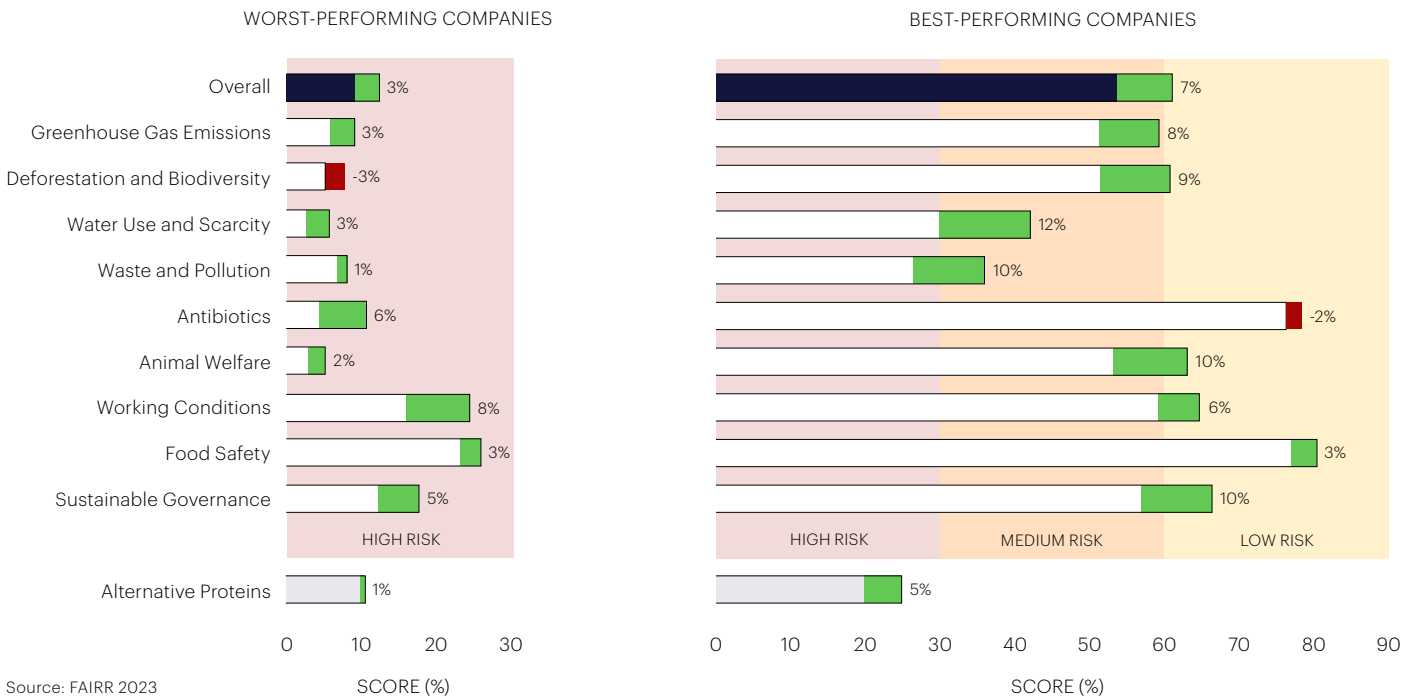
Figure 1: Average score year-over-year by ESG factor

□ 2022
 ■ 2023 increase
 ■ 2023 decrease



Source: FAIRR 2023

Figure 2: Average score changes of worst-performing and best-performing companies



Source: FAIRR 2023

The worst-performing companies – defined as those in the bottom quartile – made limited progress in all but one risk factor. An overall improvement of 8% in their scores for working conditions is especially notable. The 15 best-performing companies – defined as those in the top quartile – recorded improvements in every category except antibiotics.

Figure 3: Overall risk score by company

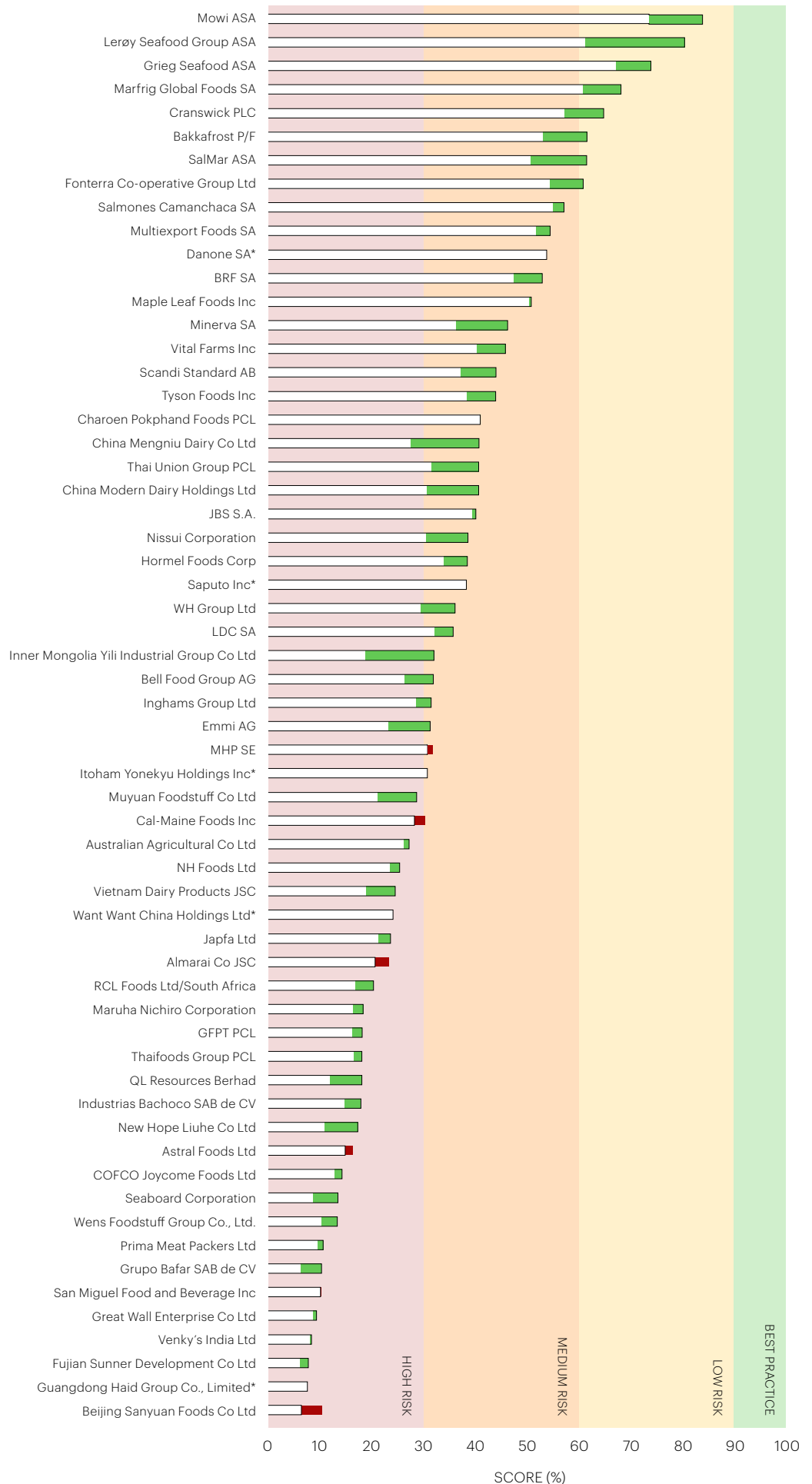
□ 2022
 ■ 2023 increase
 ■ 2023 decrease

Results overview

Many Index companies are still failing to address basic sustainability risks. Some 45% recorded a High Risk rating across all factors this year.

Significantly, however, this marks the first time that less than half of the Index’s constituents have received a High Risk rating. As well as demonstrating overall improvement in comparison with last year, this shows more companies are increasing their disclosure and sustainability performance in relation to crucial ESG risks.

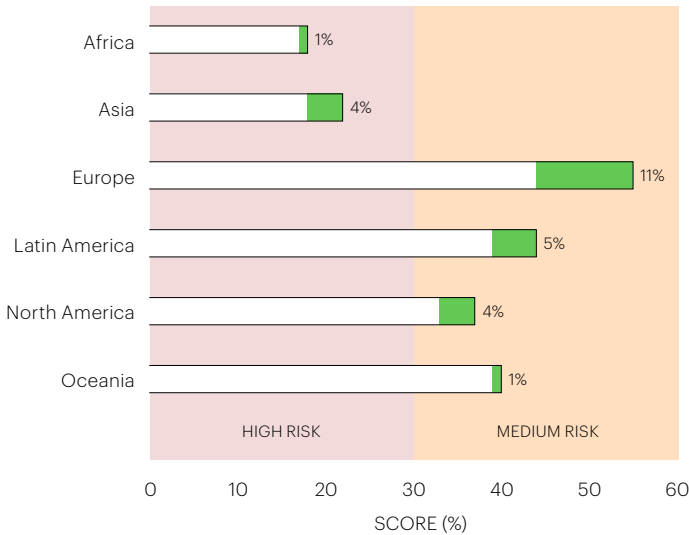
Unless otherwise stated, the company sample for the data insights is 60.



*New companies for 2023

Source: FAIRR 2023

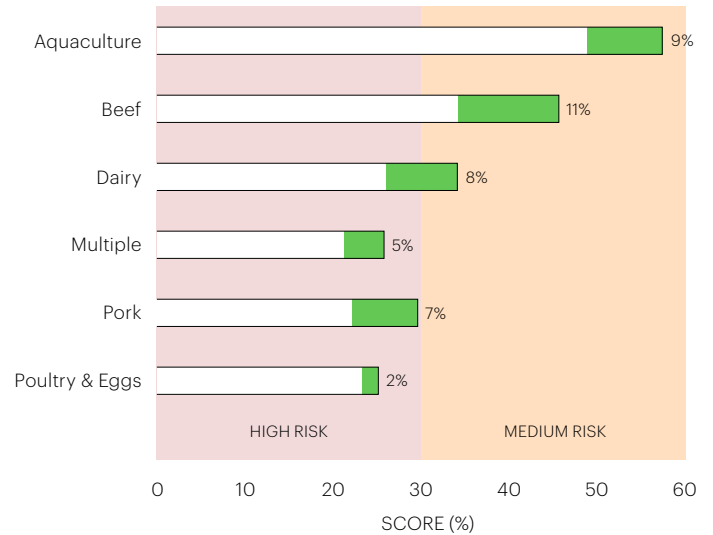
Figure 4: Average score change by region (2022 vs 2023)ⁱ



Source: FAIRR 2023

All regions demonstrated improved performance this year. Europe saw an overall score increase of 11% – in large part driven by an increase in animal welfare scores and by the strong performance of aquaculture companies, which continued to do better than their land-based counterparts.

Figure 5: Average score change by main protein (2022 vs 2023)



Source: FAIRR 2023

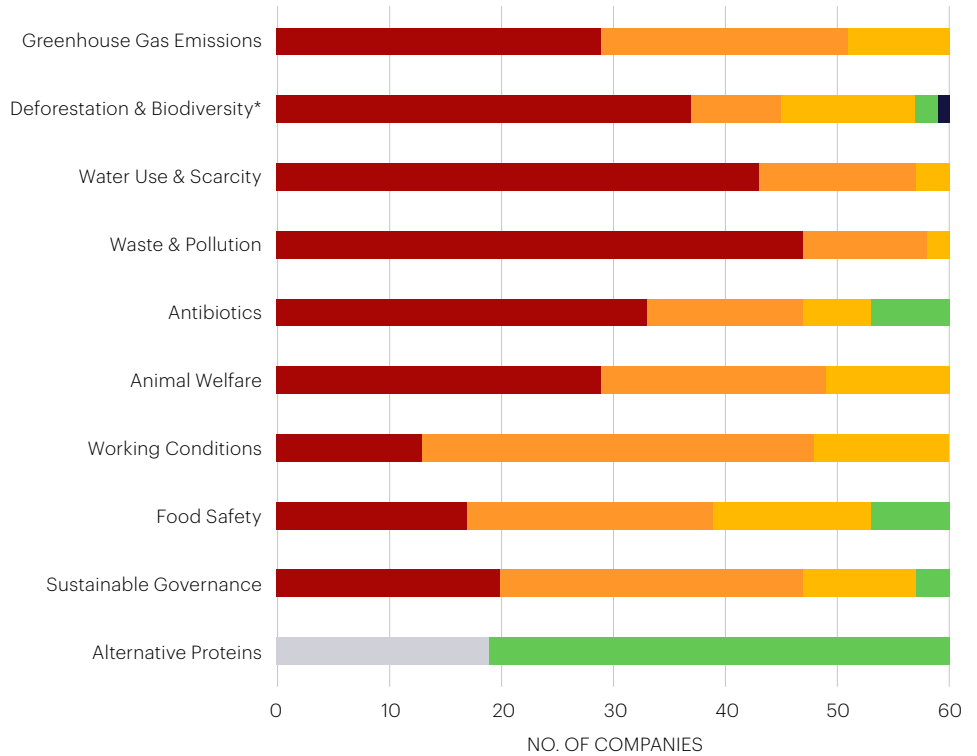
Aquaculture companies continued to outperform land-based protein producers on all risk factors. They recorded a 9% increase in average score, with every risk factor seeing a rise in performance – especially deforestation, water use and scarcity, animal welfare and governance.

Beef producers saw a notable increase of 11%, in large part driven by a rise in governance performance. However, it is important to observe that these producers recorded a decrease in relation to working conditions – a major issue in this sector during the past year, with many producers facing controversies around human capital management.

ⁱ There are two Index companies in Africa, 28 in Asia, 12 in Europe, eight in LATAM, seven in North America and three in Oceania.

Figure 6: Index companies ranked as High, Medium and Low Risk by factor

- High Risk
- Medium Risk
- Low Risk
- Best Practice
- No information
- Not assessed



*Fonterra is not assessed on deforestation since the company does not use soy

Source: FAIRR 2023

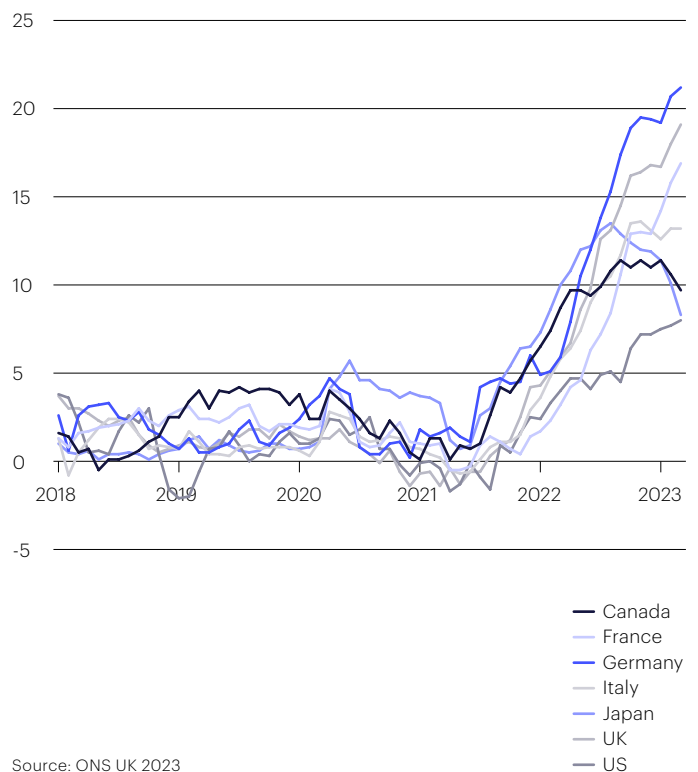
2.4 A changing global landscape

With the reopening of the economy after the COVID-19 pandemic and the ongoing war in Ukraine contributing to higher energy prices, protein producers are facing significant inflationary pressures. These have included a 22% fall in spring crops between 2021 and 2022.¹ According to the OECD, food prices have increased by 34% in Germany, 26% in the UK, 25% in the US, 23% in Canada and France, 21% in Italy and 12% in Japan since 2019.² In some areas, such as the UK, labour shortages have also been a major factor. This means all areas of the food value chain – including feed, fertiliser and fuel – are affected. As a result, the cost of production has increased – and consumers, in turn, have frequently been confronted by spiralling prices.³

In addition, with companies trying to keep expenditures as low as possible, workers are usually not awarded wage rises in line with inflation. With real wages stagnant or declining, employees may be less willing to work. This could lead to further difficulties in attracting staff, as well as high employee turnover.

These undoubtedly constitute serious challenges, yet this year’s Index findings suggest a changing global landscape has not undermined companies’ commitment to sustainability. Despite geo-economic and geopolitical uncertainty, there is continued progress in efforts to embrace practices that are fit for the future.

Figure 7: Food consumer price index inflation of G7 countries (2018-2023)

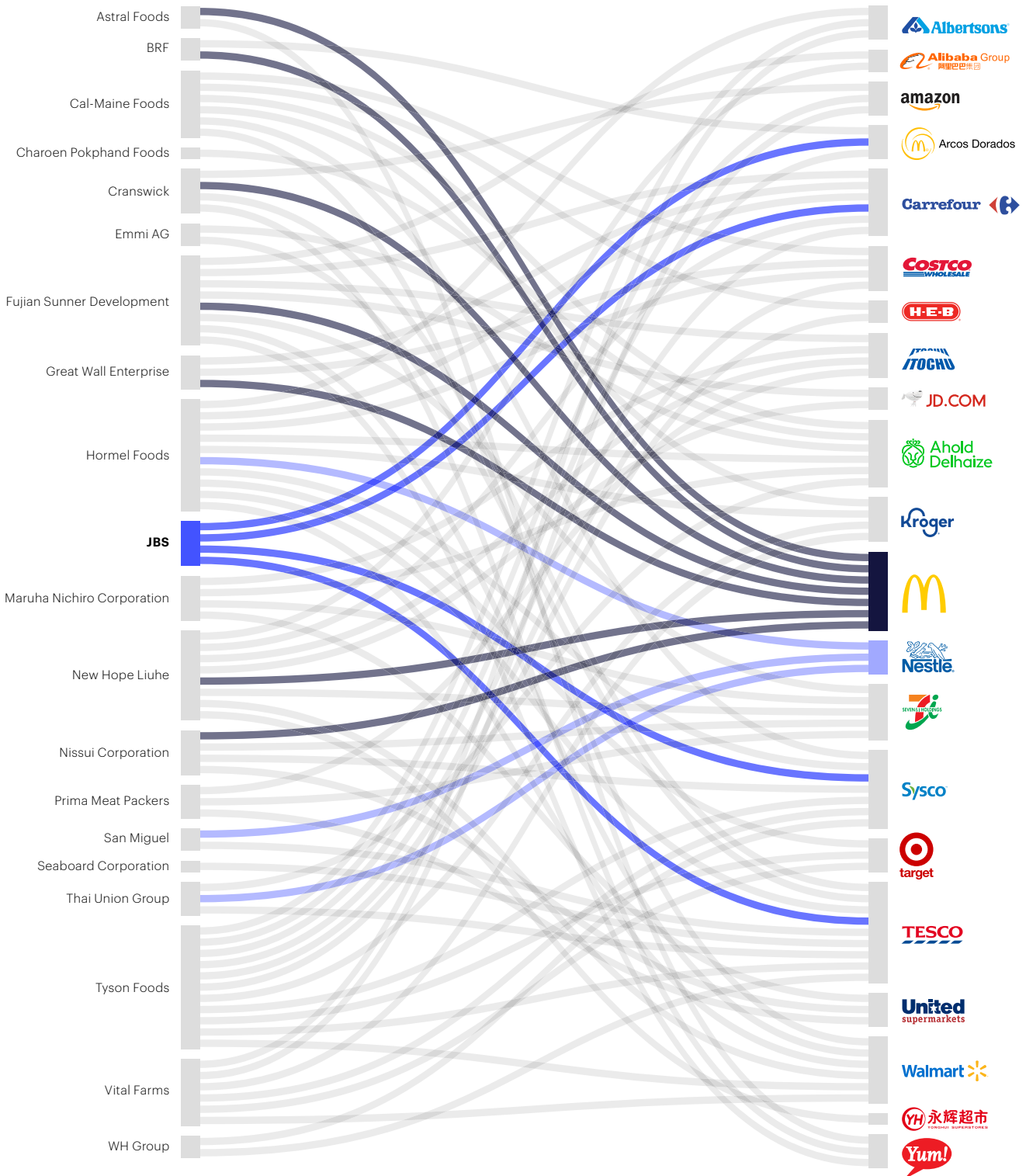


Source: ONS UK 2023

2.5 Supply chain

The findings of the Coller FAIRR Protein Producer Index underline the links between the ESG performance of protein suppliers and the ESG performance of retailers. Based on Bloomberg data, the illustrative map below enables us to identify potential policy and target gaps in these crucial relationships and to connect the risks in the supply chains of the largest consumer-facing companies (right) with the performance of suppliers (left).

Figure 8: Supply chain map



Source: FAIRR 2023

3. SBTi FLAG: more accountability for land-intensive companies



This chapter examines the extent to which the world's largest protein producers are achieving disclosure in line with FLAG guidance. This is crucial to wider understanding of whether the sector will successfully align with a 1.5°C pathway. Overall, while there are several reasons to be optimistic, the sector is still some way from achieving alignment.

The FLAG sector is responsible for 22% of global GHG emissions.⁴ Only the energy sector produces more. Many land-intensive FLAG businesses have set or committed to set targets through SBTi, but few account for the land-based emissions that constitute the majority of their GHGs.

As a result, SBTi introduced its new FLAG guidance in September 2022. This requires SBTi-committed FLAG companies to disclose their FLAG emissions to align with a 1.5°C warming scenario. The critical requirements of SBTi FLAG guidance are as follows:

- Set near-term FLAG science-based targets
- Account for removals in near-term FLAG science-based targets
- Set long-term FLAG science-based targets
- Set zero-deforestation targets for no later than 2025
- Set science-based targets for fossil fuel emissions

Only one Index company, Danone, currently discloses its FLAG target. Meanwhile, a number of others are *committed* to setting FLAG targets.

This is partly because, as of late 2023, companies with a science-based target commitment are not obliged to disclose FLAG targets. They are instead required to do so six months after the publication of the final GHG Protocol, which is expected to be published in mid-2024.⁵ However, companies setting science-based targets for the first time, updating them and/or adding net-zero targets are now required to submit FLAG targets.

3.1 Signs of progress

A third of Index companies currently have validated science-based targets or are committed to setting them. The proportion of companies that have already set such targets is 23%, compared with 16% last year. All these companies will soon need to disclose their FLAG targets.

It is possible to consider whether companies are close to setting FLAG targets by examining if they already disclose land-related emissions and removals, as well as their deforestation commitments. This is because the types of emissions and removals covered in FLAG guidance include GHGs from land-use change, land management and carbon removals and storage.

Emissions from land-use change

Four Index companies – Fonterra, Grieg Seafood, Mowi and Tyson Foods – provide details of emissions from land use, which is self-defined by a company. BRF, SalMar and Scandi Standard provide details of partial emissions from land use. Of these, only Fonterra, Tyson Foods, BRF and Scandi Standard are considered FLAG companies by SBTi. This is because aquaculture companies are not thought of as FLAG businesses. However, since aquaculture companies are responsible for land use through feed, the Index has still analysed these businesses' practices.

Zero-deforestation targets

More Index companies now provide information on deforestation. This year six disclosed that 100% of their soy is sourced from areas with no risk of deforestation or from deforestation-free suppliers, compared with five last year. In addition, 12 Index companies now have a zero-deforestation or conversion commitment, compared with eight last year. However, only four of these – Cranswick, Danone, LDC and Saputo – have set a target year by 2025, with only Cranswick and Danone having validated science-based targets.

Meanwhile, the number of beef producers mentioning that 100% of their cattle are sourced from areas with no risk of deforestation stands at two this year. The companies are Itoham Yonekyu and Bell Food Group. Two beef producers, Marfrig and Tyson Foods, have set a target of a 100% deforestation-free supply chain for their cattle. Marfrig's is set for 2030, five years past the date recommended by FLAG guidance. Tyson extended its target date to 2028, having previously disclosed its aim to achieve this goal by 2025.



Greater scrutiny of emissions inventory

Overall, Index companies are demonstrating good performance on Scope 1 and Scope 2 emissions disclosure. However, performance on Scope 3 emissions is still lagging. Furthermore, the emissions of the top 20 meat and dairy companies in the Index by market cap have increased by 3.28%, and just eight of those disclose scope 3 emissions. Three of the 20 don't disclose emissions data at all.

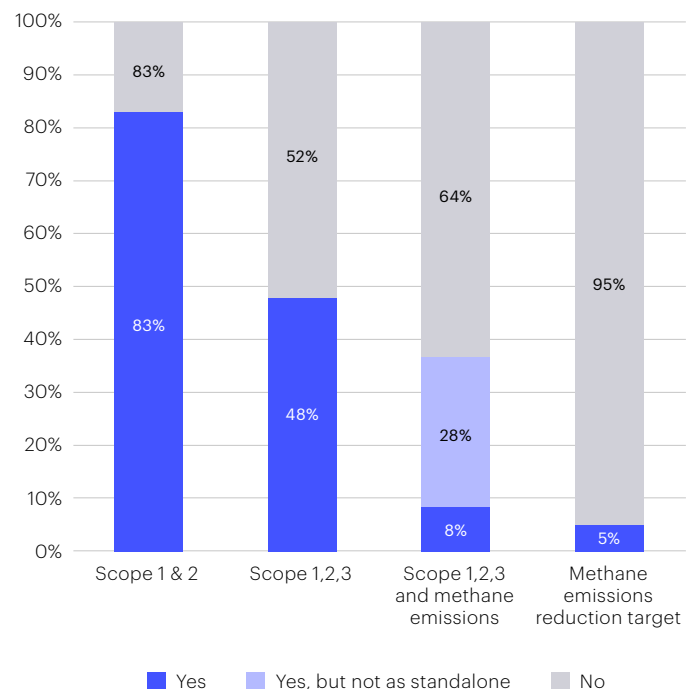
Less than half of all Index companies disclose Scope 3 metrics, even though these emissions are 5.5 times greater than Scope 1 and Scope 2 emissions combined.⁶ In addition, most data is still only partial. FLAG targets must cover at least 67% of FLAG-related Scope 3 emissions.⁷

SBTi FLAG guidance specifies the science-based rate of mitigation in the FLAG sector pathway as 3.03% per year between 2020 and 2030.⁸ Some 27% of Index companies reduced absolute emissions by more than 3.03% in 2023, but only 8% involved full inventory – that is, with Scope 3 emissions included.

Interest in methane reduction has grown since the Global Methane Pledge was launched at COP26 in November 2021. Agriculture is the largest source of global methane emissions from human activities,⁹ and methane emissions from enteric fermentation, biomass burning, nutrient management, fertiliser use and manure management are important elements of emissions from land management under FLAG guidance. Companies in this sector must start disclosing methane emissions to set credible targets.





Less than half of all Index companies disclose Scope 3 metrics, even though these emissions are 5.5 times greater than Scope 1 and Scope 2 emissions combined.

Figure 9: Quality of GHG emission disclosure



Source: FAIRR 2023

Table 1: Policy initiatives for methane emissions reduction

Country/state	Year introduced	Description	Reduction target	Baseline year	Target year
 California	2016	Senate Bill 1383 established methane emissions targets, including a reduction in statewide methane emissions of 40% below 2013 levels by 2030 and an equivalent methane emissions reduction target for the dairy and livestock sector.	40%	2013	2030
	2019	The Climate Change Response (Zero Carbon) Amendment Act set into law domestic targets of a 24-47% reduction below 2017 biogenic methane emissions by 2050, including a 10% reduction below 2017 biogenic methane emissions by 2030. By 2025, farmers will also be subjected to methane tax.	10% 24%-47%	2017	2030 2050
	2021	Ireland has committed to reducing livestock methane emissions by at least 10% by 2030. It is currently investigating several mitigation strategies, including pasture management, dietary supplementation, genetic selection and reducing the age of slaughter.	10%	2005	2030
	2022	To meet a national target of reducing methane emissions by 30% by 2030, the UK plans to introduce methane-suppressing feed for livestock from 2025.	30%	2025	2030

The Index methodology currently assesses only dairy, beef and pork companies on methane emissions targets. However, since other protein producers are also responsible for such emissions, disclosure and targets were manually checked for all 60 companies. Three companies – Danone, Itoham Yonekyu and Marfrig – currently have targets for reducing methane emissions. Five provide methane emissions disclosure as a standalone.

With national and regional governments paying more attention to methane emissions from animal agriculture, disclosure should be a priority – regardless of SBTi validation status. As Table 1 shows, policies have recently been launched in several jurisdictions. More countries

have also introduced methane-related regulation for energy sectors. The FLAG sector may be included in the near future. Companies that set FLAG targets and thereby provide methane-related disclosure will be able to respond more effectively to future methane tax systems or regulation, whether national or international.

Global overall methane emissions are still associated with upper-middle-income, lower-middle-income and low-income countries. By contrast, emissions from high-income countries have experienced a steady decrease since the 1980s. Many of the newer regulations introduced in high-income countries are increasingly encouraging the use of innovative methane-curbing technologies.

Case study: Leading the way on FLAG target disclosure



Danone is among the first companies in any sector to have FLAG targets aligned with SBTi. It has set the following targets towards net-zero emissions, with intermediate carbon reduction targets for 2030 from a 2020 baseline:

- 47.2% reduction in absolute Scope 1 and Scope 2 GHG emissions
- 30.3% reduction in absolute Scope 1 and Scope 3 FLAG GHG emissions
- No deforestation across its primary deforestation-linked commodities, with a target date of FY2025

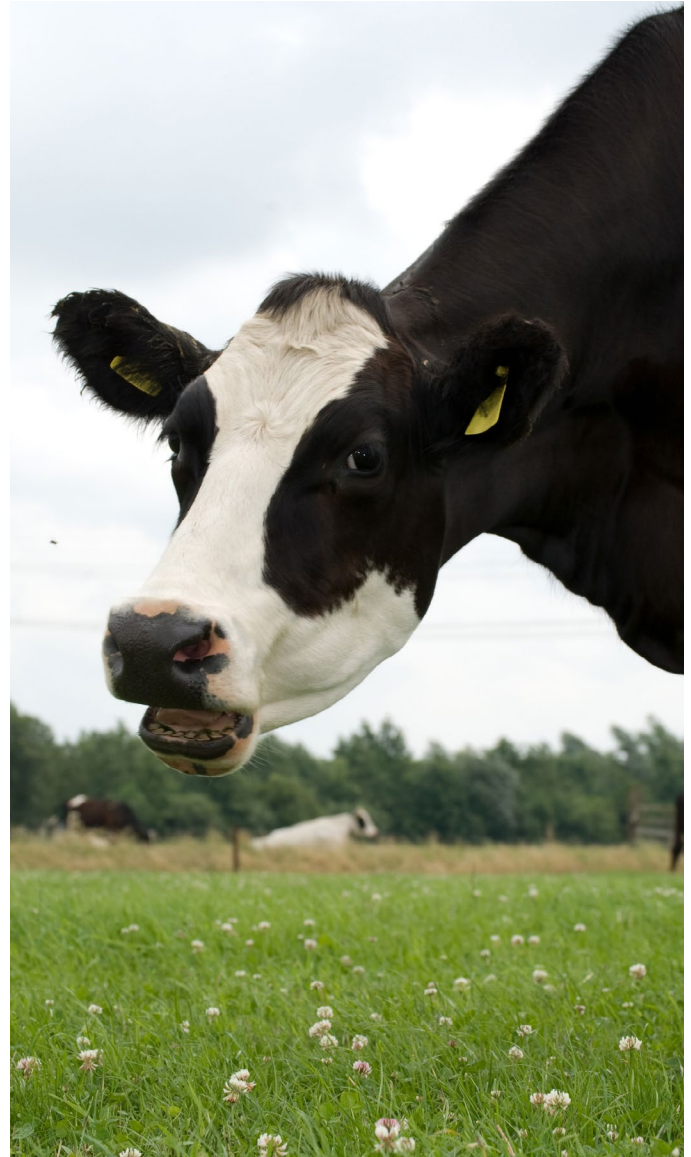
Methane targets

In 2023 Danone also committed to a 30% reduction in its methane emissions from fresh milk by 2030, aligning its efforts with the Global Methane Pledge. The company had already reduced its methane emissions by 14% between 2018 and 2020, proving it is not just making pledges but backing them up with tangible progress.¹⁰

As well as setting the above targets, Danone has developed several cutting-edge initiatives. These include projects in herd management, feed fundamentals and manure management.

Initiatives to reduce emissions

For example, through a collaboration with chemicals firm DSM and the Flanders Research Institute for Agriculture, Fisheries and Food, the company conducted an on-farm trial to reduce methane emissions by introducing a new ingredient to cattle feed. The trial confirmed a long-term methane reduction effect, with an 18.3% decrease in enteric emissions. In addition, through the use of the Cool Farm Tool developed by the Cool Farm Alliance, Danone can assess methane emissions from 92% of its milk volumes. More on Danone's Methane Ambition can be found [here](#).



Companies that set FLAG targets and thereby provide methane-related disclosure will be able to respond more effectively to future methane tax systems or regulation, whether national or international.

3.2 In practice: are companies on track for 1.5°C alignment?

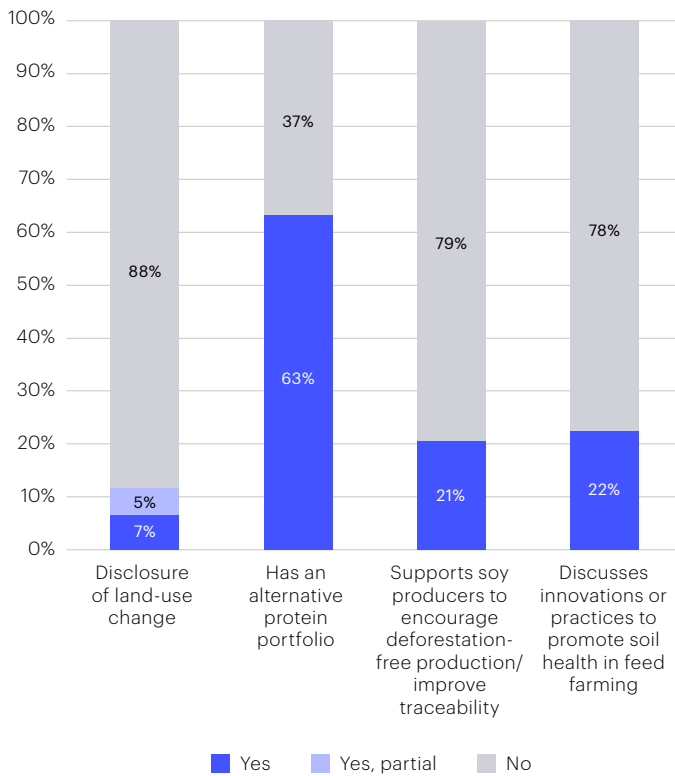
Companies with validated science-based targets can lose their validation, leading to reputational risks, if they do not meet disclosure requirements within the specified timeframe. For companies still lacking such targets, meanwhile, this route remains crucial to maintaining sustainable operations.

FLAG guidance identifies critical areas of focus for the livestock sector and highlights seven priority mitigation measures. All but two – “Reduce food loss and waste” and “Restore forests” – are relevant for protein producers. Using a number of proxy questions from the Index, it is possible to explore companies’ use of these measures – even though they may not be close to disclosing FLAG targets.

Table 2: FLAG guidance mitigation measures and Index questions

Mitigation measures	Proxy questions from the Index	Note
Stop land-use change (e.g., deforestation)	To what extent does the company disclose its GHG emissions from land-use change? Does the company have a zero-deforestation/conversion target? When is the target year and cut-off date?	The Index makes a distinction between partial and full emissions disclosure. Best practice includes a 2025 target with a 2020 cut-off date and covers all sourcing regions at risk from deforestation/land conversion.
Improve land management	Does the company disclose emissions from animal and feed farming? Does the company trial innovations in reducing emissions from animal and feed farming? Discussed in depth in the Circularity chapter.	
Shift diets	What is the company’s extent of alternative protein portfolio, does it track sales and does it have a % target?	The FLAG Guidance also includes demand-side mitigation measures to highlight opportunities.
Reduce food loss and waste	Applicable for downstream in the supply chain and hence relevant for protein consumers rather than producers.	
Restore forests	N/A	Covered as part of deforestation target.
Improve sustainable forest management and agroforestry	Does the company provide support to soy producers to encourage deforestation-free production or improve traceability?	Not including two companies that publicly disclose that they do not source soy.
Enhance agriculture soil carbon	Does the company discuss innovations/practices to move towards sustainable feed sources, or projects to promote biodiversity and/or soil health in feed farming?	Only considered companies that discuss projects to promote soil health. This question is only applicable to the 58 companies that source soy.

Figure 10: Climate reduction mitigation measures for the FLAG sector



Source: FAIRR 2023

Overall, Index data shows companies are working to introduce better demand-side measures – for example, by encouraging diet shift through alternative protein portfolios – but measures on the supply side are lacking. This underscores that the sector as a whole is still some way from aligning with a 1.5°C pathway.

One reason why the lack of progress in this regard may be seen as concerning is that FLAG targets must include a no-deforestation commitment with a target date of no later than the end of 2025. This leaves little space for companies to start disclosing their targets.

There are still opportunities, however. For example, with almost half of all Index companies already disclosing full inventory, methane disclosure should follow. With year-on-year emissions disclosure increasing, companies may be expected to continue to improve their performance in relation to relevant metrics.

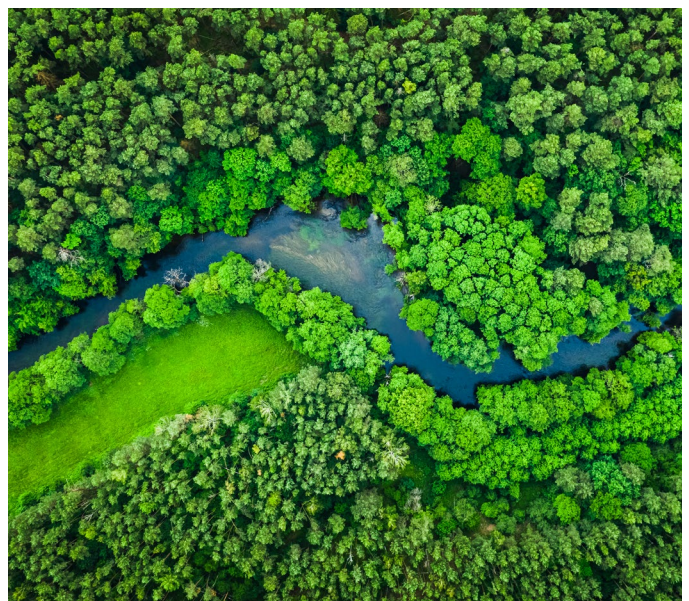
3.3 The trend in Asia

Thai Union is the only Asian Index company to have a validated science-based target. This was set in June 2023. Two other companies, Charoen Pokphand Foods and Inner Mongolia Yili, are in the process of developing such targets. Smithfield Foods (part of WH Group) previously had one, but its commitment was removed by SBTi in light of a lack of progress.

Despite Thailand not being a signatory of the UN pledge to end deforestation by 2030,¹¹ Thai Union is also leading the way in terms of deforestation targets. It is aiming to introduce 100% zero deforestation and conversion across its entire supply chain by 2030. In last year’s assessment, by contrast, the company committed only to source certified soy.ⁱⁱ

In April 2023, similarly, China Mengniu Dairy announced a commitment to achieving zero deforestation by 2030. None of the other 15 Chinese or Japanese Index companies that source soy has such a target, even though both countries are signatories of the UN pledge.

Eight Asian companies now provide Scope 1, Scope 2 and Scope 3 emissions disclosure – up from five last year – with Nissui and WH Group disclosing full inventory for the first time (the third addition to this group is Itoham Yonekyu, a newcomer to the Index this year). Thai Union also disclosed an emissions reduction target including Scope 3 emissions for the first time.



ii Itoham Yonekyu publicly discloses that it does not source any soy.



3.4 In summary

Danone is unique among Index companies in disclosing its FLAG targets. Another 17 companies are expected to set them in the next two years. Going forward, given the trend of increasing disclosure year-on-year, more robust commitments can be expected. It remains to be seen, though, whether companies will be able to keep pace with SBTi deadlines.

FLAG targets must include a no-deforestation target by 2025, yet only four FLAG-sector companies have achieved or set a target in line with this requirement. There is now little room for companies to ensure such targets are met.

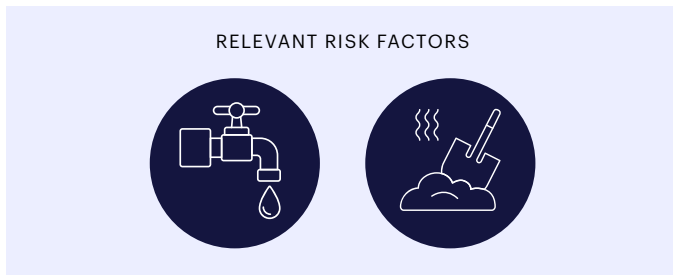
Methane emissions disclosure is lagging, but pressure to improve is clearly mounting. Several jurisdictions have already introduced measures to curb emissions, including

discussions over methane tax. While current regulatory changes are essentially confined to high-income countries, companies everywhere must be ready to deal with future initiatives – and investors, too, should be prepared.

Although most Index companies have encouraged diet shift by incorporating alternative proteins in their portfolios, disclosure around FLAG guidance mitigation measures is limited. Businesses have considerable scope to promote soil health, but only 22% of Index companies that source soy currently do so.

Asian Index companies continue to lag in terms of disclosure related to FLAG guidance, but there are signs of progress. Thai Union has become the first Asian company to have a validated science-based target, while two others now have deforestation targets – although the dates are set for 2030, which is not in line with guidance.

4. Circularity: going further than footprints



This chapter explores the steps companies are taking to realise the full value of the waste, by-products and co-products produced through their activities. It discusses if and how companies are addressing circularity across their production cycles – that is, waste, nutrients and water – and considers both the opportunities and the risks presented by more circular systems. A mix of progress and problems is reported.

The concept of circularity is gaining significant ground in several regions. For example, the European Commission adopted its new circular economy action plan (CEAP) in March 2020 as one of the main building blocks of the European Green Deal.¹²

Crucially, circularity in the food value chain is specified in the CEAP. The European Commission has expressed its intention to consider “specific measures to increase the sustainability of food distribution and consumption”.¹³

4.1 Circular waste management

As discussed in previous FAIRR reports,^{14,15} the global food system generates more than three billion tonnes of animal waste each year. In terms of sheer weight, this easily exceeds the annual totals for human waste, food waste, waste sent to landfill and even the amount of plastic produced worldwide.

Analysis has exposed how the sector often mismanages this waste, leading to acute environmental impacts. Inadequate management presents a risk to companies and their investors, whereas appropriate management can reduce risk and create opportunities.

Due to the high cost of inputs such as feed and fertiliser, maximising the use of all materials and by-products is essential in realising the full value of a company’s investments. Using waste materials can decrease the need for inputs and cut associated emissions.

However, FAIRR’s engagement with companies has shown that environmental concerns come second to yield maximisation.¹⁶ As a result, Index companies implement circular waste management systems to varying degrees.

The importance of repurposing animal waste

The sheer volume of animal waste generated by the global food system poses a serious threat to the environment and biodiversity.¹⁷ The array of polluting substances contained in manureⁱⁱⁱ – including nutrients, heavy metals and antibiotic residues – demands effective management.

Unlike human waste, animal waste is not generally dealt with by using municipal systems. It is instead composted or treated before being applied to land.¹⁸ Failure to apply it in a controlled way can result in constituents leaching out of or running off soils, entering waterways and surrounding lands and causing pollution and eutrophication events.

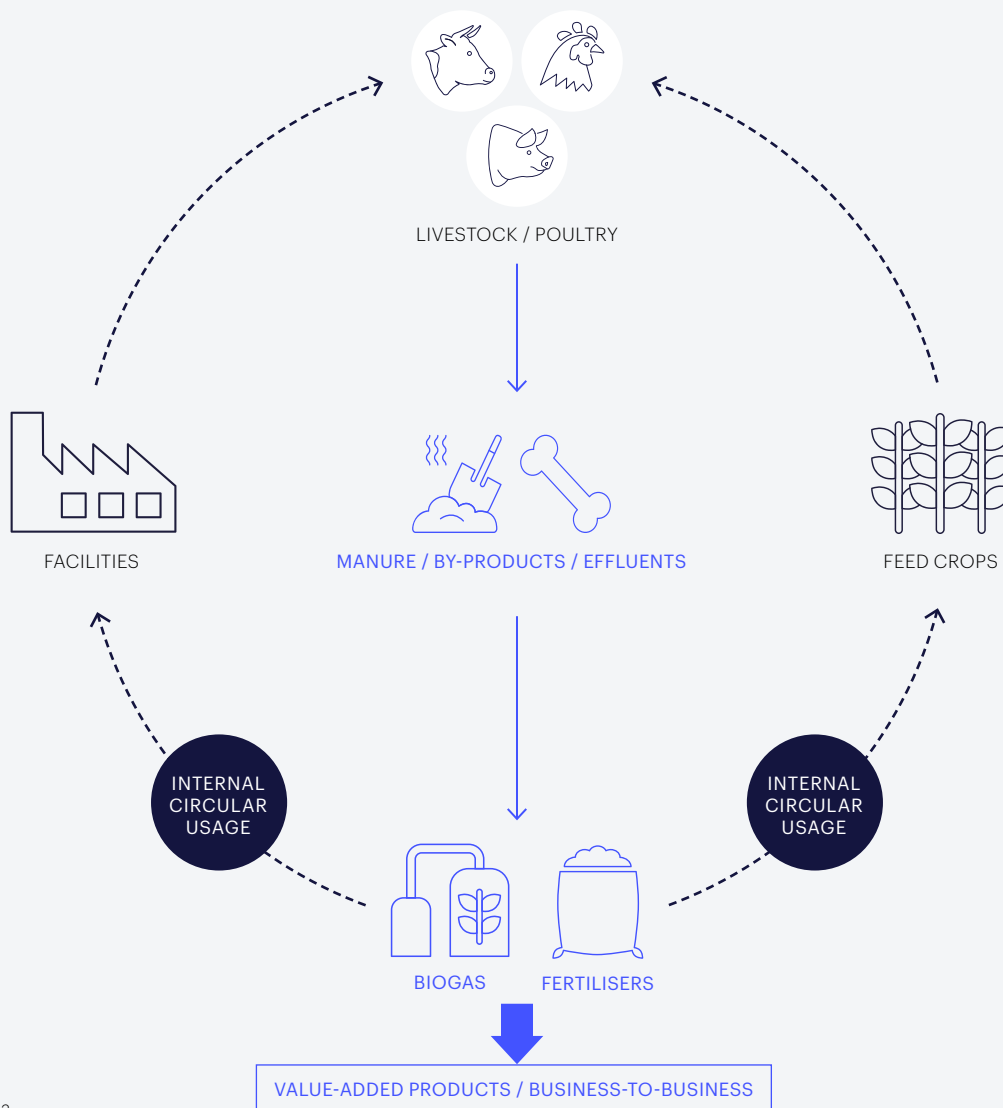
How manure is managed can also impact a company’s emissions through the release of methane and other GHGs from waste. Excluding emissions from land-use change and animal feed, livestock and manure account for 5.8% of GHGs globally.¹⁹ Using manure as an organic fertiliser or for biogas power generation can reduce a company’s on-farm emissions and use of GHG-heavy synthetic fertilisers and fossil fuels.

Truly circular waste management may involve using fertilisers or biogas within a company’s own operations – for example, to grow feed crops^{iv} or as a non-fossil power source for facilities. However, FAIRR’s analysis has shown such an approach is rarely undertaken by companies, with many simply transforming waste into additional revenue streams.

iii “Manure” is used as a general term covering slurry, litter, slaughter waste and all other organic waste created in the meat and dairy production cycle.

iv Despite the risks associated with manure and the impacts that uncontrolled application can pose to biodiversity and ecosystems more generally, it is important to note that animal waste contains two nutrients that are key for plant growth: nitrogen and phosphorous.

Figure 11: Circular opportunities in livestock farming



Source: FAIRR 2023

A closer look at repurposing manure and processing by-products for biogas

Manure and effluents^v can be processed into biogas via anaerobic digestion. This allows emissions to be captured and utilised for power generation rather than being emitted into the atmosphere.

Half of all Index companies report processing manure and effluents to produce biogas, but some of these sell their gas to the national grid or to third parties in the regions where they operate. Companies are thus able to generate additional revenue from their waste but do not address the initial consumption of fossil fuels within their own operations.

Conversely, 30% of Index companies use the biogas they produce within their own operations – at least to some extent. For example, Charoen Pokphand Foods reported

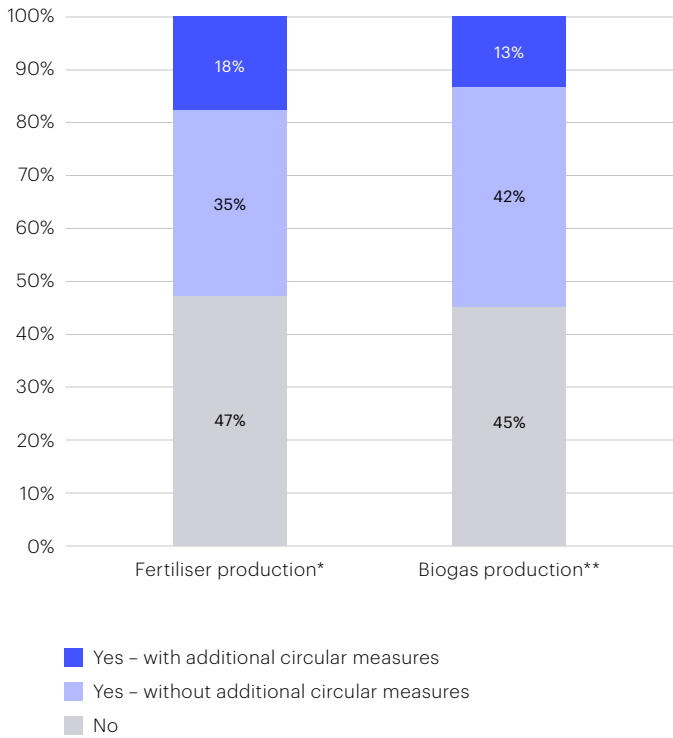
that in 2022 biogas was used to replace 68.4 GWh of electricity, avoiding 440,000 tCO₂e emissions²⁰ – equal to more than 36% of the company's Scope 2 emissions.²¹ Recent life-cycle assessments have shown anaerobic digestion improves GHG emissions from manure but still has eutrophication impacts similar to those of current practices²² – highlighting the need for nutrient management to be combined with this approach. However, as shown in Figure 12, this is currently lacking.

Due to the large initial investment required to achieve optimal use of manure and effluents as biogas, financial support must also be provided to suppliers throughout a company's value chain. For example, Charoen Pokphand Foods supports contract farmers in installing systems to use biogas produced from the waste of pig-farming operations.²³ Less vertically integrated companies cannot expect to tackle their upstream waste generation or associated emissions on a material scale in the absence of such provisions.

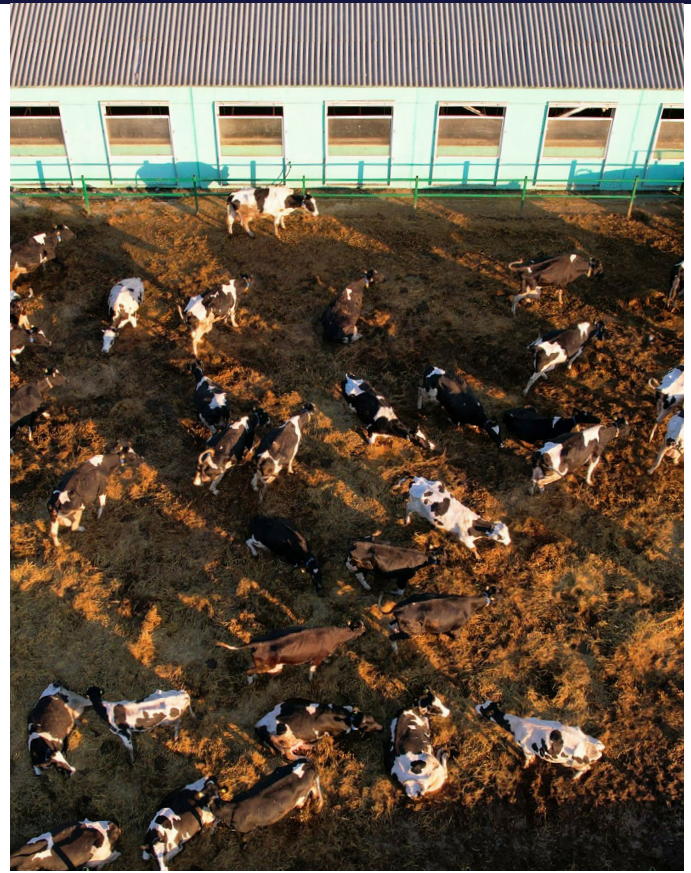
^v Applicable to all forms of protein production except dairy farming.

Minority of companies take steps to treat slurry sustainably or adopt circular measures when converting manure to fertiliser

Figure 12: Extent of sustainable practices in manure conversion into fertiliser and biogas



* Circular measures include collaboration with fertiliser companies, transport to nutrient-poor watersheds or feed use that lowers nutrients excreted;
 **Circular measures refer to sustainable slurry management;
 Note: The analysis on fertiliser production excludes aquaculture companies (sample size is 51 companies)
 Source: FAIRR 2023



A closer look at repurposing manure and processing by-products as fertiliser

Fertilisers can be produced through the composting and treatment of manure and animal by-products from processing operations. Waste materials can thus serve as a resource to grow crops and improve soil health – replacing traditional synthetic fertilisers, which are not only expensive but have a large carbon footprint. Some 29 Index companies engage in this practice.

The production and use of fertilisers for feed-growing purposes can act as a truly circular system, whereby excess nutrients that pass through an animal or are lost during slaughter and processing are captured and used again in feed production. Australian Agricultural is one Index company that reports using its own manure to grow feed crops,²⁴ citing benefits such as reduced costs, lower emissions and improved soil health.²⁵

This kind of utilisation often depends on financial support from companies to put in place the infrastructure to transport manure to crops. For example, Muyuan reported that by 2022 it had installed a total length of 19.7 million metres of pipeline to get manure to farmers for free – resulting in application over 350,000 hectares of land, saving the use of 58,700 tonnes of chemical fertiliser and leading to increased income for farmers.²⁶

Many companies are working with third parties to utilise waste products. Table 3 highlights some of these companies and their procedures.^{vi}

vi This is not an exhaustive list of examples.

The controlled application of organic fertilisers is vital to reducing nutrient runoff. Twenty Index companies disclose using nutrient management plans (NMPs) or similar when applying fertilisers – both organic and synthetic – but only Muyuan, Wen’s, China Modern Dairy, New Hope Lihue and China Mengniu Dairy report applying biogas residues in a sustainable manner (see Figure 12).

Notably, these five companies are Chinese. It is likely that extra due diligence is required when applying fertilisers in China, due to strict regulations imposed by the country’s Zero Growth in Synthetic Fertiliser Use strategy.²⁷

Due to the potential impacts that the inappropriate use of fertilisers can have, it is key for companies to assess their exposure to nutrient pollution risk in order to inform nutrient management plans, fertiliser applications and manure and waste management more generally. Sixteen Index companies have identified operations located in areas of medium or high risk in terms of sensitivity to water pollution, while 14 of the companies that produce fertiliser from manure and by-products have undertaken such an assessment.

Case study: Innovation in organic fertilisers

Smithfield

In 2018 Smithfield Foods announced a partnership with Anuvia™ Plant Nutrients to utilise materials from the company’s manure treatment facilities to create organic fertilisers. Organic

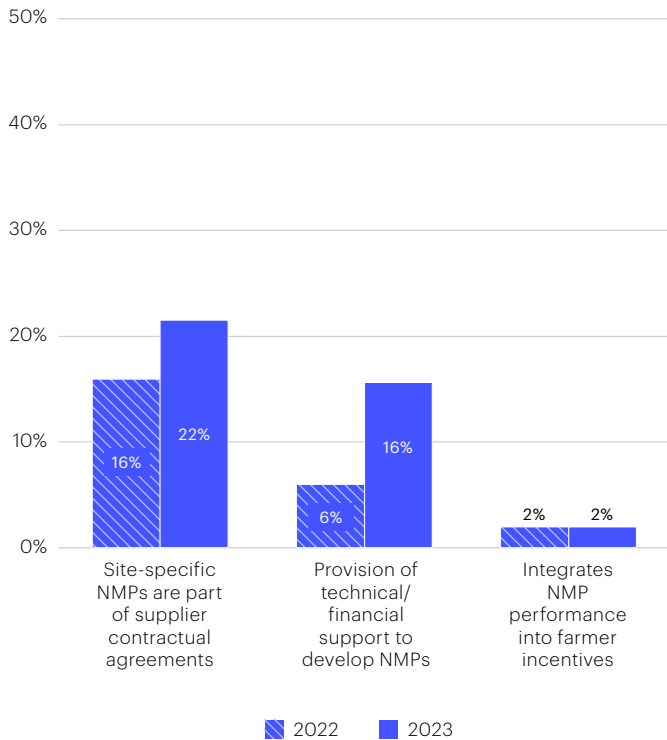
matter is concentrated and processed to form a commercial-grade fertiliser with a controlled nutrient release, thereby lessening the likelihood of post-application nutrient runoff²⁸ and reducing potential downstream impacts.

Within this partnership, Smithfield can purchase fertiliser at a subsidised rate – providing a clear pathway for previously wasted nutrients to be returned to the company’s feed crops and thereby closing the loop of nutrient transfer to form a circular system. The fertiliser produced reportedly reduces the leaching of nitrogen by 50% and cuts GHG emissions by 32% per acre of crop compared to traditional products.^{29,30}

Table 3: Examples of third-party waste management

Description	Benefits	Companies
Launching a subsidiary that processes organic waste into fertiliser products	Less reliance on imported fertilisers, which represent 85% of fertilisers currently used in Brazil.	
Sending manure to third-party compost manufacturers	Specialised manufacturers are more advanced in waste management and can turn manure into higher-quality fertilisers.	 
Collaborating with private companies to process manure into fertiliser	Fertiliser can be bought by feed farmers at subsidised rates (see case study) or used on contracted farms.	  
Subsidising transport of manure to nutrient-poor watersheds	Helps redistribute nutrients.	  <small>肉食产业链 美味更健康</small>

Figure 13: Use of nutrient management plans (NMPs) in animal farming operations



Note: Sample size is 51 companies in 2023 and 50 in 2022 as this question applies to companies that have revenue derived from land-based proteins

Source: FAIRR 2023

ARGs and antibiotic resistance

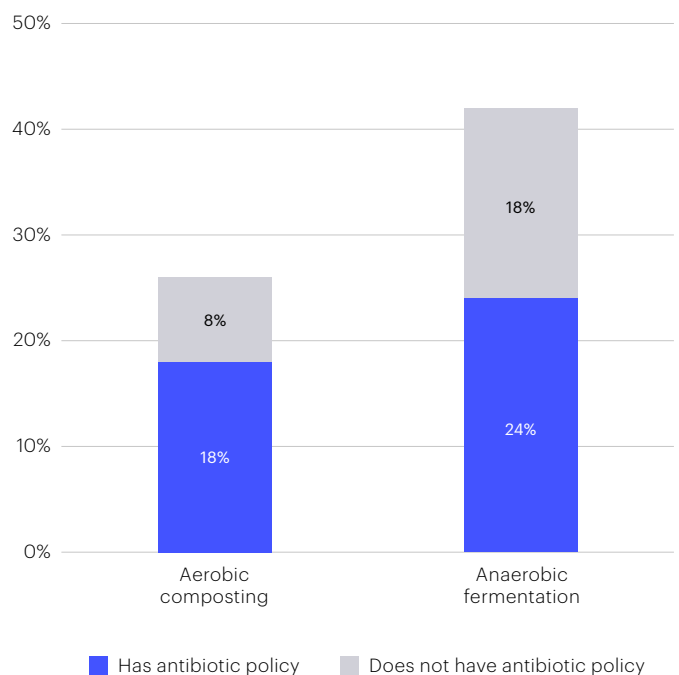
One of the risks associated with using livestock manure as organic fertiliser is the spread of antibiotic-resistant genes (ARGs) and bacteria. Soil accounts for approximately 30% of known ARGs in repositories, making it one of the largest environmental reservoirs of antibiotic resistance.³¹

The problem stems largely from the routine use of antibiotics in industrial animal farming to mitigate the effects of poor welfare practices.³² Despite offering economic benefits to producers, this non-therapeutic usage exacerbates pollution and antibiotic resistance when untreated manure is used as fertiliser.³³ Studies show 70-90% of antibiotics administered to animals are excreted unchanged in manure,^{34,35} fostering antibiotic resistance in soil bacteria and earthworms' gut microbiota, while increased ARG transfer to plants has been observed in soils with significant antibiotic exposure.³⁶

Raw animal manure utilisation therefore demands more sustainable methods in order to mitigate environmental and public health harm.³⁷ Although effective treatment of manure entails a cost, the societal gains are clear.³⁸ Present conversion methods reduce ARGs and pathogens considerably but cannot fully eradicate them.³⁹ Current degradation rates range between 17% and 99% and are significantly impacted by factors such as the technique employed (i.e., aerobic composting versus anaerobic fermentation), the specific conditions and length of the process, the concentration and type of antibiotic present and the origin of the manure by species.⁴⁰

More than half (53%) of all Index companies convert manure into fertiliser, either through anaerobic fermentation as by-product of biogas production (30%) or through aerobic composting (22%). However, only half of the companies that use anaerobic fermentation have an antibiotic policy, while two thirds of those that use aerobic composting have one. Given the risk of ARGs, which is higher for anaerobic fermentation, there is a need for stronger commitments.

Figure 14: Antibiotic policy disclosure among companies treating manure for fertiliser



Note: Sample size is 51 companies that have revenue derived from land-based proteins

Source: FAIRR 2023

Improvements in manure processing are essential to counter the risks associated with antibiotic resistance through organic fertilisers. The above methods are essential for reducing the risks associated with antibiotic residue. However only with a strong antibiotic policy can the full benefits of manure treatment into fertiliser, such as renewable energy and soil nutrient preservation, be materialised.^{41,42,43}

Waste management in the aquaculture sector

Aquaculture continues to be the food-producing sector with the highest annual growth rate.⁴⁴ Environmental change, population growth and a decline in naturally occurring fisheries and food availability suggest coastal and open-water aquaculture will continue to play an increasing role in food security over the coming decades. However, concerns remain about the environmental impact of waste generated from “fed” aquaculture systems – including Atlantic salmon, the primary focus of aquaculture in the Index – on coastal ecosystems.⁴⁵ Two main streams of waste are present in these operations: uneaten feed and faeces generated by the farmed species.

FAIRR’s analysis has shown European-based industry leaders’ disclosure across metrics linked with waste and pollution in aquaculture is robust. This indicates the best-performing companies are taking this issue seriously.

Table 4: European aquaculture companies have higher waste-related and pollution-related disclosure

Metric	% companies	Company names
Risk assessment	40%	SalMar, Grieg, Bakkafrost, Mowi, Leroy and Thai Union
Organic loading	43%	SalMar, Grieg, Bakkafrost, Mowi, Leroy and MultiExport
Inorganic loading	14%	Leroy, MultiExport
Faecal strategy	27%	Grieg, Leroy, Mowi, SalMar

Note: Companies in blue refer to European aquaculture companies

While there are proposed and implemented management practices, Integrated Multi-Trophic Aquaculture (IMTA) presents a case for mass adoption if certain limitations can be overcome in practical ways. It could represent a significant opportunity in circularity for investors over the coming years. By cultivating additional commercially relevant co-species in the same locality, IMTA expands the traditional linear model of “fed” single-species production to a whole-ecosystem approach. The dual waste streams of the original or “fed” species – unconverted feed and produced faeces – are used in situ, feeding the growth of the complementary or “extractive” species occupying lower stages of the food chain.





One example is the introduction of shellfish such as mussels, which filter organic matter from the water, and species such as sea lettuce, which filter inorganic matter. Research has shown certain forms of dissolved nitrogen, which are primarily responsible for aquaculture’s contribution to harmful algal bloom events, can reduce concentration in adjacent waters by up to 70% when these biofilters are present.⁴⁶

Although the concept of IMTA has been present in the academic literature since the early 2000s⁴⁷, the commercial viability of the practice has been uncertain. The regulatory framework for aquaculture in the EU and wider regions is complex and extensive. National frameworks are generally amenable to IMTA pilot schemes, but substantial regulatory reform is required for commercial expansion.⁴⁸

In addition, there is a high degree of complexity associated with integrated systems and a need for additional skills above and beyond those necessary to manage already highly sensitive single-species systems.⁴⁹ IMTA requires real-time data to monitor each species, and companies have not had this capability until recently. However, in light of continued advances in AI-based big-data technologies,⁵⁰ IMTA is becoming more feasible and increasingly scalable.

Systems akin to IMTA are now being explored by at least four of the ten aquaculture-focused companies in the Index. One is Lerøy Seafood Group, which has been publicly investigating the commercial viability of IMTA through its partner company/subsidiary, Ocean Forest, since 2014. The company states its interest in using mussels and five varieties of algae to increase the volume of marine raw materials harvested for the same volume of input feed. Although no official target date for profitability has been set, volumes of harvested seaweed have increased tenfold – to 232 tonnes – since 2016.⁵¹




Table 5: European aquaculture companies' involvement in IMTA

	Association type	Details
	Active research	Discloses exploring IMTA through its subsidiary, Ocean Forest.
	Active research	Discloses exploring the co-farming of shellfish alongside its Atlantic salmon.
	Cooperative farming	Operates farms adjacent to seaweed-producing, WWF-backed start-up Ocean Rainforest.
	Investment	Listed financier of the Canadian IMTA Network.

The number of companies exploring this method suggests the shortfall in skills and perceived technological challenges may be at least partially addressed, leading to the possibility of an exponential rise in popularity if regulatory issues can be overcome. The potential to utilise co-produced species in the feed basket of a farm also has promising implications for the required uptick in the use of alternative proteins – as addressed in FAIRR’s Sustainable Aquaculture engagement.⁵²

However, investors must be aware that claims of circularity do not absolve companies of environmental risk. Unless a holistic approach is taken, circular products can cannibalise any positive impacts that circularity may achieve. Table 6 outlines the pros and cons of an IMTA-style system, the use of which should be considered carefully.

Table 6: Advantages and disadvantages of IMTA

	Advantages	Disadvantages
 COST	More raw material farmed from the same amount of feed	Large investment requirement Large space requirement Specialist skillset requirement
 REVENUE	Can command a premium price Product diversification / new income streams Potential source of sustainable feed	Species limitations Income imbalance between species, discouraging uptake
 OPERATIONS	Potential for disease control Less nutrient leakage into the environment	Food safety concerns

While highly technical, Integrated Multi-trophic Aquaculture presents important opportunities to address waste and pollution. Indeed, four of ten aquaculture companies report IMTA trials or research.







4.2 Alternative feeds

Upstream of the food value chain, feed suppliers play an important role in mitigating the risks associated with nutrient management. Alternative feeds that thrive on waste products also bring circularity within food production. While most conventional soy, corn and palm oil production is linear, requiring extensive fertiliser usage, insect feed and microalgae production have been designed to solve waste problems. This is not going unnoticed: of the 18% of Index companies that invest in alternative feed – which also encompasses feed with reduced deforestation risk – nearly a third now invest in sustainable feed production that aims to address nutrient pollution, including approaches that adopt regenerative farming practices targeting soil health.

Biorefinery and circular feeds

Companies that seek to reduce the risks arising from deforestation and/or the rising price of conventional feed ingredients are increasingly exploring alternative feeds produced from by-products. Such feeds have the added benefit of improving circularity in production while also tackling nutrient pollution associated with conventional feed production or waste disposal. It is important to note that farmed animals can have very contrasting diets, as shown in the table below. Optimal feed compositions may therefore vary greatly between different species.










Table 7: Farmed animal dietary categories

Feed type				
Grains (e.g. corn & wheat)	●●●	●●●●	●●●●	●●●●●
Plant-based protein (e.g. soybean)	●●	●●●	●●●	●●●
Fish meal	●●	●	●	n/a
Vitamins & minerals	●	●	●	●
Fish oil	●	●	●	n/a
Insects protein	●●	n/a	●	n/a
Forage (ex. hay)	n/a	n/a	n/a	●

● = 20%

Major aquaculture companies in particular are increasing their expenditure on R&D related to alternative feed. FAIRR's engagement with these companies has shown the health and welfare of salmon to be key considerations when selecting alternative ingredients.⁵³ More broadly, the following table summarises companies that are actively investing in three different alternative feeds with a high potential to cultivate circular systems

Table 8: Examples of alternative feeds used among Index companies

	Protein type	Microalgae	Insect meal	Processed animal protein (PAPs)
Lerøy Seafood Group ASA		●●●	●●●	●●●
SalMar ASA*		○●●	○●●	●●●
Mowi		●●●	●●●	●●●
Greig seafood		○○○	○○●	●●●
Multiexport Foods SA		○○○	○●●	●●●
Charoen Pokphand Foods PCL	Multiple	○○○	○●●	●●●
Thai Union Group PLC		○○●	○○○	○○○
New Hope Liuhe Co		○○○	○●●	○○○
Japfa Ltd	Multiple	○○○	○●●	○○○
Salmones Camanchaca SA		○○○	○○○	●●●
Bakkafrost		○○○	○○○	●●●

●●● Discloses feed is adopted
 ○●● Discloses being tested as a fraction of feed mix
 ○○● Discloses not yet implemented in feed mix
 ○○○ Does not disclose

■ Discloses feed is part of circular system
 ■ Does not disclose feed is part of circular system

*SalMar also produces salmon oil

Microalgae biomass: converting contaminants into nutrient-rich feed

Water authorities have been studying microalgae biomass as a mechanism for treating wastewater since the 1950s. This is because of its efficient fixation of inorganic nitrogen and phosphate.⁵⁴ Most recently, nutrient, energy and water integrated recovery (NEWIR) systems that use algae cultivation have been found to produce nutrient-rich feed while improving eutrophication impacts and mitigating GHG emissions.⁵⁵ The microalgae sustainably accumulate by-products – including proteins, carbohydrates, lipids, vitamins and amino acids – positioning this as a natural, nutrient-rich, circular livestock feed source.^{56,57}

Introducing microalgae as feed has been shown to enhance defence activity, tissue protection and antioxidant effects in several animal species and has even affected pigmentation in fish.⁵⁸ Research has also suggested it could replace fishmeal and fish oil in aquaculture feed and improve growth and meat quality.^{59,60} Four Index companies were found to be exploring/adopting this alternative feed, although none disclosed use of microalgae produced from agricultural wastewater in a circular system.

Insect feed: converting complex organic by-products into nutrient-dense feed

Insects have a unique capacity to bio-digest low-value organic waste with a complex composition, such as agricultural by-products. In turn, they exist as a high-protein, low-impact biomass that requires minimal land, water and attention to cultivate while producing low GHG emissions.⁶¹

Extensive research has explored the application of insects in animal nutrition – including black soldier fly larvae, mealworms and crickets^{62,63} – and how circularity may be engineered.^{64,65} Findings reveal positive effects on animal health, with opportunities to lower the use of antibiotics in livestock production.⁶⁶ In addition, insect excrement (known as frass) may be used as an organic fertiliser⁶⁷ or to feed microalgae, with studies demonstrating faster growth versus other waste inputs⁶⁸ – hence doubling the circularity of this novel solution.

Eight Index companies were found to be exploring/adopting this alternative feed, with one explicitly referencing a circular application. Japfa Ltd reported working with Gadjah Mada University to use black soldier fly larvae as a bioconversion agent, turning poultry waste into flour and oil for use as alternative feed.

Processed animal protein as feed

Meat for human consumption is separated from animal by-products (ABPs) after slaughter.⁶⁹ In the EU alone more than 20 million tonnes of ABPs – which might include skin, bones, horns, hooves, blood, fat and offal – are generated annually. This presents a significant source of high-quality protein waste that can be repurposed as feed for non-ruminant livestock.^{70,71} However, as acknowledged by organisations such as the European Commission, the associated risk of spreading animal diseases or transmitting pathogens to human consumers via the food chain must be mitigated.⁷²

In 2001, in the wake of the BSE epidemic, the EU imposed a total ban on feed containing ABPs.⁷³ Twenty years later it authorised the use of insect, pig and poultry proteins, along with ruminant collagen/gelatine, to feed non-ruminants – prompting some companies to explore the potential of such approaches.⁷⁴

For example, poultry producer Standard AB is now investigating opportunities to mitigate waste while increasing profitability through exporting ABPs to be used as feed.⁷⁵ LDC, another poultry producer, is looking at the possibility of feeding ABPs to its livestock.⁷⁶ The updated EU regulation still prohibits intra-species recycling (i.e., cannibalism) but aims to close the EU's protein gap by alleviating dependence on imported soy for feed, thereby reducing carbon footprints in line with the European Commission's Farm to Fork strategy.⁷⁷

International standards currently include only a ruminant-to-ruminant feed ban.⁷⁸ While the US and many other countries use "by-/co-products" to refer to carcass cuts other than dressed meat, EU regulations explicitly define ABPs as "any part of the animal carcass or any material of animal origin not intended for human consumption".⁷⁹ These regulations then divide ABPs into three categories. Categories 1 and 2 are classed as high-to-intermediate-risk and include infected or contaminated by-products. Category 3 is classed as low-risk,⁸⁰ with such ABPs referred to as PAPs – an acronym derived from "processed animal protein".

Nine Index companies provided disclosure confirming the use of PAPs in feed. Eight of these generate significant revenue from aquaculture.

SalMar ASA's strategy aims to increase the company's use of trimmings and co-products by 2023 and discloses that 32% of marine ingredients are derived from trimmings.⁸¹ SalMar also discloses R&D into using salmon oil as a feed ingredient,⁸² which, due to salmon's cannibalistic nature, does not carry a BSE risk.

Lerøy Seafood Group ASA's Wild Catch segment focuses on preserving residual raw materials and producing PAPs that can be reintroduced into the company's value chain as feed.⁸³ As shown in Table 8, Lerøy is one of seven PAPs-using companies that indicate their own by-products are used to produce feed internally.

As discussed in a previous FAIRR report,⁸⁴ although there are circularity benefits to using PAPs in feed, it is important not to overlook that the production system may be inheriting various ESG risks. PAPs should be sourced with the same scrutiny applied to virgin feed products.

Despite these positive trends and growing evidence of best practice in the more innovative areas of nutrient management in feed, no Index company reported having a requirement in place to purchase feed from suppliers or to produce feed with an NMP. At a basic level, protein producers should at least require suppliers to set verified NMPs for major commodities used as ingredients in animal feed. In line with guidance from the Sustainability Consortium, verified NMPs should meet the criteria of EPA Comprehensive Nutrient Management Planning or the Farmer Sustainability Assessment of the Sustainable Agriculture Initiative (or equivalent).

4.3 Circular water management

Water is one of the most important resources for animal protein production, playing an invaluable role in all stages of the value chain. However, a recent study found the “green water” boundary (precipitation, evaporation and soil moisture⁸⁵), which is intrinsically linked to weather patterns and rainfall, has been exceeded.⁸⁶ Given that an estimated 4,387km³ of water is required to produce the feed consumed by the global livestock sector – and 94% of that total is green water⁸⁷ – circular water management is pivotal for protein producers.

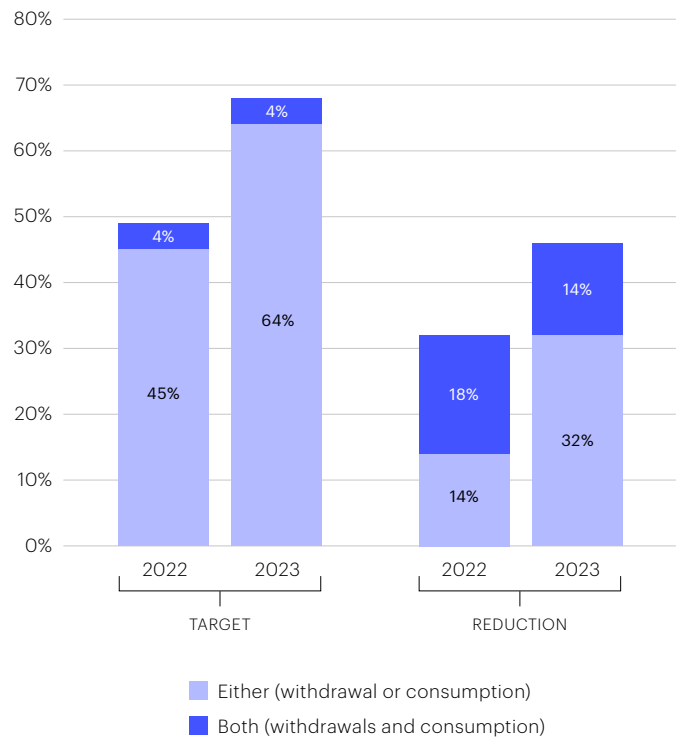
Thirty Index companies reported completing or being in the process of conducting a risk assessment to identify processing facilities that operate in locations with medium or high water stress. Although this represents an improvement from 2022’s figure of 25, the World Resources Institute’s Aqueduct tools⁸⁸ show all the companies that have not undertaken a scarcity-related risk assessment operate in countries with regions of high or extremely high water stress.

Seven companies reported the proportion of feed sourced from water-stressed areas, with four of these disclosing this information for all feed commodities. Meaningful action plans are unlikely to be implemented without a clear idea of the level of risk to which areas of a company’s value chain are exposed.

Some 26 companies disclosed a target to reduce water consumption at their facilities, with four setting one during the past reporting year. Nineteen of the 26 completed a risk assessment related to water scarcity, but only eight disclosed a target to reduce water withdrawals.

According to FAIRR’s analysis, eight Index companies decreased both water consumption and withdrawals during the past reporting year. This compares with ten in 2022. Eighteen reduced either one or the other – up from eight in 2022 – while 22 reported the volume of water withdrawals or consumption from water-stressed areas, compared with 20 last year.

Figure 15: Water management in processing facilities



Note: companies that have conducted a water risk assessment demonstrating they operate in areas of low water risk or that do not have processing/slaughtering facilities are not assessed. Sample size is 56 companies in 2022 and 55 in 2023.

Source: FAIRR 2023

Many companies report water savings from site-specific action plans, but the lack of comparable company-wide data makes assessing efficacy difficult. Company-wide reporting on this issue is most likely to generate investor confidence in the implementation of water reuse strategies.



Regulations restrict the use of reclaimed water from processing facilities in some regions. For example, the Brazilian Federal Inspection Service (Sistema de Inspeção Federal – SIF) has banned the direct use of reclaimed water in production areas, prohibiting its use for animal watering or thermal comfort.⁸⁹ In the US, conversely, Cal-Maine has reported using eggshell-washing water for evaporative cooling systems in its laying hen facilities – a move the company has credited with improving efficiency compared to misting systems for poultry.⁹⁰ Regional differences must therefore be assessed to understand how and where water reuse can be implemented within value chains.

Ten companies, located in Asia and Latin America, use wastewater from facilities for the “fertigation” of crops. This strategy realises savings in both water and fertiliser inputs for irrigation, thereby enhancing circularity on two fronts. However, the feasibility of such an approach relies on infrastructure to collect and then transport wastewater to agricultural areas, with financial implications depending on the distances involved.

The EU’s new Water Reuse regulation, which came into effect in June 2023, aims to facilitate and encourage the practice of reusing water for irrigation in agriculture.⁹¹ It has a particular focus on harmonising the monitoring of water quality to enable increased reuse. Going forward, this could lead to fertigation becoming a readily implemented practice for companies operating in the EU – although, as discussed previously, sufficient treatment is essential to reduce the risk of ARG transmission.

On the whole, many companies have yet to truly realise circular water management and reduce associated water risks. By way of illustration, consider JBS: it utilises 9% of all effluent wastewater for fertigation but also reports 55% of effluents are discharged into water bodies annually.⁹² Like several other companies, JBS cites this discharge as meeting regional regulations. Yet regulations are often set so as not to exclude smaller producers. Large-cap companies can seek to work beyond existing regulations in reducing their environmental impact.

Circular water management represents a clear opportunity for companies to mitigate water scarcity risks. However, to realise the material benefits it offers, companies must first identify where risk is most prevalent within their value chains. Through a robust risk assessment, watersheds, ingredients or specific sites can be targeted with initiatives that ensure the greatest return from investment in relevant technologies and practices from a risk-mitigation perspective.



4.4 In summary

Circularity is gaining traction in the animal protein production industry as a sustainable approach to resource optimisation. However, it does not absolve a company of the range of key risks associated with circular products.

A core aspect of circularity involves converting manure and effluents into biogas through anaerobic digestion, with around 55% of Index companies globally adopting this practice. Some sell biogas for revenue, while others use it internally to reduce emissions and fossil fuel reliance. Repurposing manure and by-products into fertilisers, thereby reducing carbon footprints, is another circular practice.

Using manure as organic fertiliser is essential for circular agriculture, but it poses risks such as ARGs and bacterial spread. Advanced processing techniques, including anaerobic fermentation and aerobic composting, mitigate these risks while generating renewable energy.

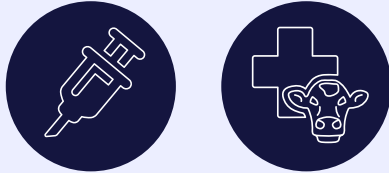
Alternative feeds that thrive on waste products also bring circularity within food production. Encouragingly, many companies are now finding ways to incorporate such feeds.

By contrast, almost half of all Index companies have not conducted risk assessments for processing facilities in water-stressed areas. In addition, few have set targets to reduce water withdrawals effectively.

Embracing circular practices, managing risks and addressing resource vulnerabilities are key steps towards enhancing sustainability and resource efficiency in the animal protein production industry. Further progress is therefore to be welcomed.

5. Antibiotics and animal welfare: a vital link

RELEVANT RISK FACTORS



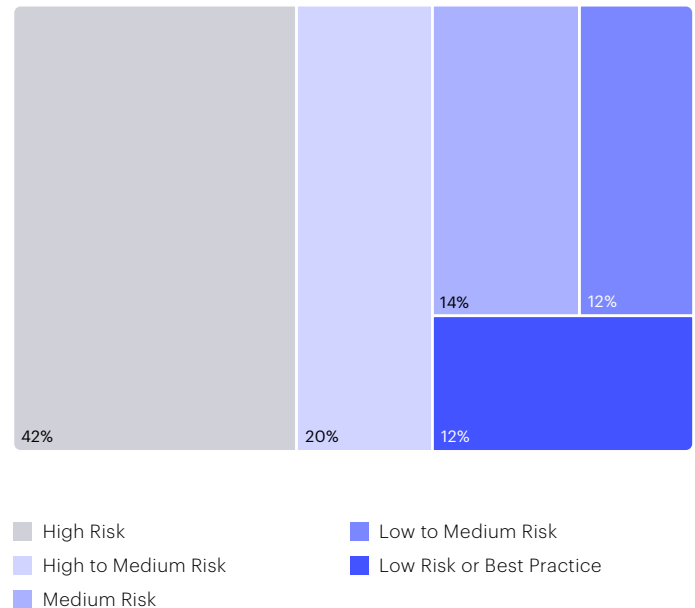
This chapter sheds light on the link between the use of antibiotics and animal welfare, explaining the benefits of taking a holistic view of these two considerations – not least in light of an evolving regulatory landscape. Based on their performance in relation to these issues, Index companies are divided into different groups. The questions investors might ask in attempting to drive further positive change are also considered.

Antimicrobial resistance (AMR) presents a risk to both human health and animal health. As such, it is considered one of the top public health threats worldwide by the WHO.⁹³ Globally, approximately 70% of the use of antibiotics is currently channelled towards livestock production – not for treating diseases but to promote growth or prevent disease⁹⁴ – which can contribute significantly to antibiotic resistance⁹⁵ and undermine good hygiene and husbandry practices.

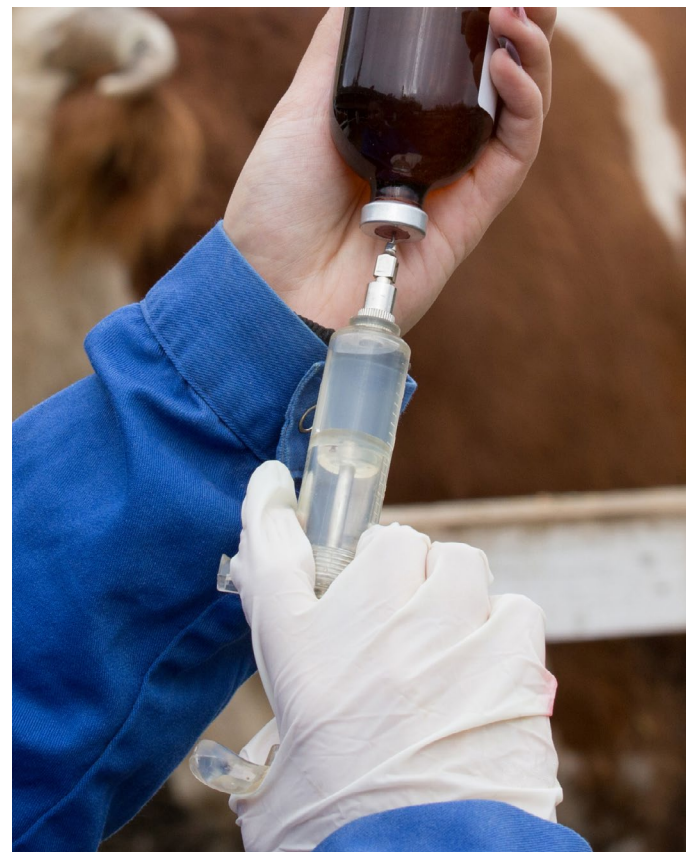
Nearly half (42%) of all Index companies are rated High Risk for their performance in relation to both antibiotics and animal welfare. Moreover, only 12% are rated Low Risk in relation to both.

Nearly half of all Index companies are rated High Risk for their performance in relation to both antibiotics and animal welfare. Only 12% are rated Low Risk in relation to both.

Figure 16: Distribution by companies' risk categorisation for antibiotics stewardship and animal welfare







Source: FAIRR 2023



5.1 Regulation and company policies

Many countries are driving their own national AMR plans, with some also increasingly stipulating animal welfare requirements within the context of AMR concerns. The table below highlights regional examples.

Table 9: AMR government policies and animal welfare requirements

Region	Policies	Animal welfare	Summary of the policy and animal welfare scope	Timeframe
	Farm to Fork Strategy*	Included	This initiative is focused on fostering more sustainable food systems, with an emphasis on enhancing animal welfare and reducing the usage of antibiotics in livestock farming. It aims to reduce by 50% overall EU sales of antimicrobials for farmed animals and in aquaculture by 2030.	2020-2030
	National Action Plan	Included	The plan emphasises the importance of improving animal health and welfare to reduce the need for antibiotics in the first place. It states that the UK “also works with veterinarians and industry representative groups to support training and public engagement to reduce infection in our animals and to promote their health and welfare”. In partnership, it has also developed standards on animal welfare and responsible use of medicines.	2020-2040
	National Action Plan	Not included	This plan requires a veterinary prescription for the purchase of animal antibiotics. It does not stipulate that antibiotics should be used only for disease treatment, and the prophylactic use of antibiotics is still allowed. The plan also strives for higher animal hygiene and biosecurity measures, but it has no specific animal welfare requirements	2022-2025
	National Action Plan for Combating Antibiotic-Resistant Bacteria	Not included	This plan set several targets for between 2015 and 2020. However, a 2022 progress report showed most were not met, and animal welfare is not mentioned. The Veterinary Feed Directive in 2023 also encompasses animal welfare measures aimed at reducing antibiotic usage. In 2023 the FDA has taken steps to eliminate the use of medically important antibiotics for growth promotion in farm animals and bring their remaining therapeutic uses under veterinary supervision.	2015-2020
























*Under ongoing review by the EU Commission.

Source: FAIRR 2023



Climate change further exacerbates the risks associated with poor animal welfare – particularly by adversely influencing animal health, productivity and fertility. Understanding how the phenomenon impacts different animal production systems is vital for investors to assess companies’ resilience and adaptive capacity. Investors who do not consider these risks in their portfolios may face financial losses and increased volatility as the effects on animal welfare become more pronounced and widely recognised. This means proper animal welfare management is even more pertinent. The table below highlights some of the legislation currently in force in key Index regions.

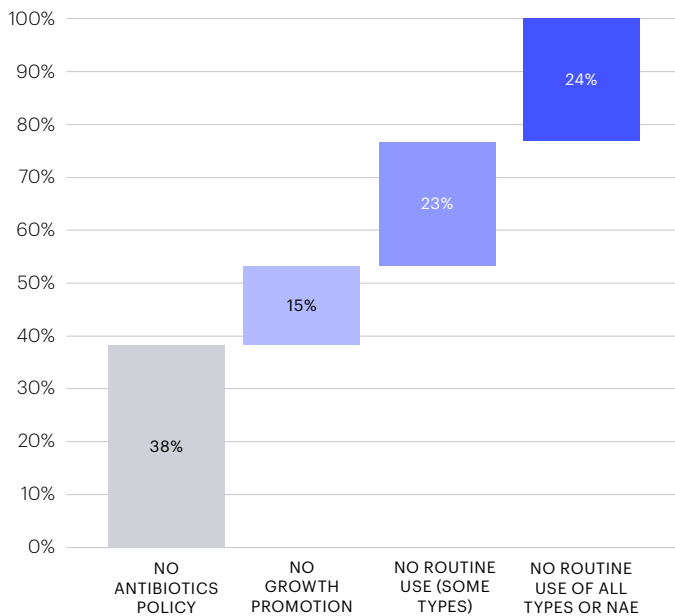
Table 10: Key national and regional animal welfare policies

Region	Name	All species - import and export	Product labelling for animal welfare traceability	Transportation conditions and slaughter standards	Cage-free for all species	Housing conditions and stocking density	Sustainable farming ex. free-range and organic	Year launched
	Farm to Fork Strategy							2023
	Animal Welfare Act	All species <i>UK farming only</i>						2006
	Animal Husbandry Law of the People’s Republic of China (amended in 2015)	Land species <i>Chinese farming only</i>		Slaughter – pigs only		Suitable conditions		2017
	Animal Welfare Act	No – does not include any farm animals						1960

Source: FAIRR 2023

On the other hand, companies are also assessed on their antibiotics performance. The proportion of Index companies with a “No antibiotics policy” is 38% in 2023, while the proportion with a “No growth promotion” policy is 15%. Meanwhile, 23% of companies reported adhering to a “No routine use of some types of antibiotics” policy in 2023.

Figure 17: Distribution of companies by antibiotic policy



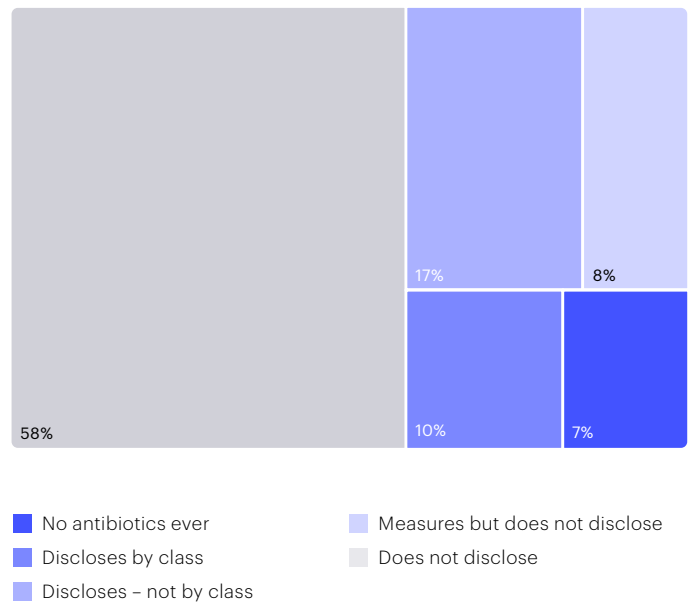
Source: FAIRR 2023

Adoption of “No routine use of all types of antibiotics” or “No antibiotics ever” is seen among 24% of Index companies. Five companies within this category, accounting for 8% of the Index, have adopted best practice in the form of a “No antibiotics ever” (NAE) policy.

This year 23% of Index companies disclosed in relation to the quantity of antibiotics used, and within this subset 29% also disclosed the specific type of antibiotics used. Some 7% reported the use of Medically Important Antibiotics (MIA), yet none disclosed against Critically Important Antibiotics (CIA) or High-Priority Critically Important Antibiotics (HPCIA). Notably, 7% disclosed zero use of antibiotics – representing current best practice.

Despite the mounting threat of AMR, two third of companies do not disclose or/and do not track antibiotic usage in their animal production

Figure 18: Antibiotic disclosure among Index companies



Source: FAIRR 2023

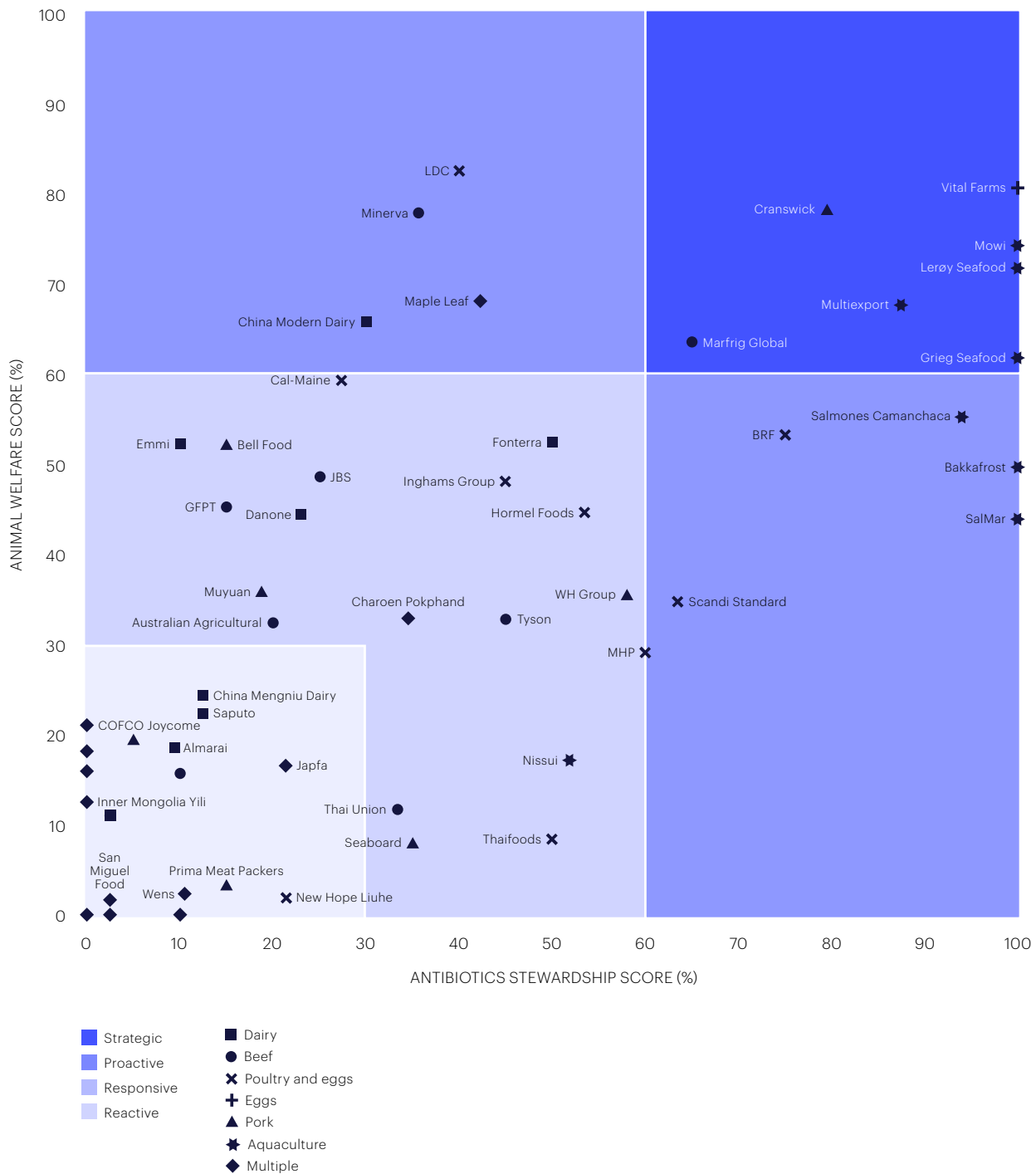
5.2 Understanding the relationship between antibiotic stewardship and animal welfare

Ensuring the wellbeing of animals is a practical necessity for maintaining healthy and productive livestock and poultry. Stressful and overcrowded conditions in industrial farming can increase the risk of disease outbreaks, necessitating the use of antibiotics to prevent and treat illnesses – which is why the *responsible* use of antibiotics and improved animal welfare practices go hand in hand.

By focusing on these issues in tandem, protein producers can both enhance the sustainability of their operations and contribute to public health by reducing the spread of antibiotic resistance. This dual emphasis underscores the need for a holistic approach to animal husbandry which benefits animals, consumers and the broader environment. By extension, underperformance in one domain may serve as a warning that the other could also be compromised.

Based on leading/lagging performance in relation to antibiotics and leading/lagging performance in relation to animal welfare, the Index can be divided into different groups. These are summarised below, using examples from each to highlight the risks and opportunities involved.

Figure 19: Index companies' distribution of antibiotics stewardship scores vs animal welfare scores



Source: FAIRR 2023

Strategic: Score Low Risk or Best Practice

The companies in this group show an exemplary adherence to antibiotics and animal welfare guidelines, making them industry leaders in both arenas. They align with current global policies, potentially mitigating regulatory risks and adverse market implications.

Four of the seven companies are aquaculture companies, which, unlike their terrestrial counterparts, tend to have policies prohibiting antibiotics for routine use. Aquaculture companies also tend to have better disclosure of animal welfare metrics.

Case studies: holistic approaches to animal welfare and antibiotics



An organic egg producer, Vital Farms, is a top performer on both fronts. It is unique in disclosing key welfare risks in laying hens. It states that 100% of its egg production is cage-free, as certified by Humane Farm Animal Care’s (HFAC) Certified Humane “Pasture Raised” standard. All hens have year-round access to outdoor pastures and nest boxes for egg-laying. Vital Farms also states it does not use any antibiotics, and Certified Humane audits this information through a certification programme that requires each farm’s medical records to be reviewed.



Another non-aquaculture high performer, Cranswick, is the only pork producer in this group. It prohibits routine use of all types of antibiotics, including for growth promotion, and is one of the few companies to provide reasons for its use of antibiotics – explaining, for example, that increased use in its pig-farming businesses was due to labour and supply chain issues. The company says the use of antibiotics across its pig and poultry farms remains well below the industry average. Cranswick enhances animal welfare through commitments to humane slaughter and the avoidance of close confinement, routine mutilation and long-distance transportation. It performs highly on assurance and certification, disclosing that 79% of the pork produced on its farms is certified to RSPCA standards and 100% is certified to Red Tractor standards.

Proactive: Low and Medium Risk combination

These companies have a Low Risk rating for one factor and a Medium Risk rating for the other. There are therefore two groups – one with sound management of antibiotics but moderate management of animal welfare, and vice versa.

Better antibiotics, needs improvement in animal welfare – potential transition risks

The companies in this group exhibit a strong stance on antibiotic stewardship but have weak animal welfare policies in place. Being deficient in the latter may expose them to upcoming regulatory actions and reputational risks, given the growing global focus on animal welfare.

Impending EU regulations will require a transition towards cage-free egg farming. This could pose significant risks for Scandi Standard and MHP SE; both companies are categorised as Low Risk in terms of antibiotic policy but exhibit average performance in the realm of animal welfare.

A key question for such companies is how they are able to deliver on their antibiotic policies if their disclosure on animal welfare has gaps – especially if, like Scandi Standard and MHP SE, they operate in the EU. Scandi Standard currently has no disclosure on maximum stocking density, use of nest boxes, prohibition of cages or barren and unsuitable environments for egg-laying hens, while MHP SE presents general statements concerning animal welfare but falls short of providing precise details regarding stocking density, methods of stunning, employment of superior welfare breeds and environmental suitability.



What can investors ask?

Engagements centred around minimising the use of antibiotics and the enhancement of animal welfare may be viewed as mutually reinforcing. Investors can seek further evidence of antibiotic policy implementation, such as tracking volume and purpose of antibiotic use. Investors can also challenge companies that aim to limit their use of antibiotics without publicly demonstrating what animal welfare measures are in place and the coverage of independent third-party verification.

Better animal welfare, needs improvement in antibiotics – where opportunities exist

The companies in this group have substantial initiatives around animal welfare but moderate antibiotic stewardship management practices. As a result, they could face risks in light of the global drive to reduce antibiotic resistance.

Antibiotics are often used to treat and prevent bacterial infections in dairy cows, yet all Index dairy companies are currently in the Medium Risk or High Risk categories for this risk factor. They generally perform better on animal welfare, but only China Modern Dairy received a Low Risk rating.

China Modern Dairy performs particularly well on disclosure of key material risks in animal welfare. For example, it addresses all key welfare risks in dairy, including no tethering, lameness prevalence, mastitis incidence and providing suitable environments. The company also emphasises the importance of avoiding strict confinement and ensuring a safe and comfortable environment for cattle, which could minimise the use of antibiotics. However, since it lacks disclosure on types of antibiotics used and does not provide reasons for use, there are clear opportunities for improvement.



What can investors ask?

Investors with holdings in these companies might first confirm whether animal welfare measures are sound. This likely means auditing or verification by third parties. They should also seek to understand when antibiotics are used – for example, in feed or for therapeutic purposes – and which preventative measures are used, such as vaccinations and alternative feed additives. They might then ask companies to formalise the use of antibiotics through a public antibiotic policy that clearly states which antibiotic classes and use practices are prohibited, scope of coverage and timeline for implementation of the policy. Investors can also request companies to disclose antibiotic use data and set targets to achieve lower use of antibiotics, since animal welfare practices would support this.

Responsive: Medium Risk or Medium and High Risk

This group comprises the 14% of Index companies that received a Medium Risk rating for both factors and the 20% that received a combination of Medium and High Risk ratings. Several Asian aquaculture companies feature – including Charoen Pokphand, Nissui and Thai Union, all three of which are rated Medium Risk in relation to antibiotics and Medium or High Risk in relation to animal welfare.



What can investors ask?

The companies in this group show some commitments but can improve. Investors can urge them to provide better disclosure, especially around policies and outcomes. Companies should publicly disclose their antibiotic policies – clearly stating which antibiotic classes and use practices are prohibited, scope of coverage and timeline for implementation – and should also collect data on reasons for and volume of antibiotic use in order to show policy adherence. Investors can also ask companies to demonstrate awareness of key material animal welfare risks, to explain the measures put in place to mitigate these and to reveal their level of certification in relation to relevant best practice.



Reactive: High Risk across both factors

The companies in this group received High Risk ratings for both antibiotics and animal welfare, signifying a gap in sustainability and welfare principles adherence alike. Asian companies in particular appear to be behind the curve, with 20 out of 28 Asian Index companies featuring in this group



What can investors ask?

Investors can view these metrics as representing imminent vulnerabilities that could influence a company's standing in light of regulatory shifts and evolving consumer preferences that increasingly lean towards products characterised by higher welfare standards.^{96, 97} Addressing these matters can mitigate the risk of reputational damage and financial repercussions and set a trajectory for long-term stability and growth. Investors can ask companies to collect data to understand the scope of and reasons for antibiotic use within their operations and encourage them to develop and publish antibiotic policies in line with best practice. Companies should also publicly demonstrate awareness of the key material animal welfare risks they are exposed to and state which measures have been put in place to mitigate these, including seeking certification to best practice animal welfare standards.

5.3 In summary

The intertwined nature of antibiotic stewardship and animal welfare necessitates a comprehensive approach to investment analysis. By considering the dynamics in these areas, investors can better assess risks and opportunities and foster investment strategies that align with sustainable business practices.

Only 12% of Index companies are considered Low Risk on both these fronts. Companies that misuse antibiotics or fail to adhere to progressive animal welfare standards risk reputational damage, regulatory sanctions and potential market share erosion – all of which can profoundly affect investor returns.

Conversely, companies that embrace responsible practices stand to benefit from enhanced brand value, consumer loyalty and adaptive resilience in an ever-tightening regulatory environment. This is especially the case in Europe.

6. Human capital risks: mounting pressure to demonstrate transparency and equitability

RELEVANT RISK FACTOR



This chapter focuses on the human capital risks that companies must manage, especially as some businesses struggle with labour shortages while global consumption of animal protein increases. In particular, it examines turnover, employee safety and fair wages, providing insights into the working conditions of protein producers and the various steps that can be taken to mitigate risk and improve performance.

As discussed in last year's report, the COVID-19 pandemic cast the importance of social risk management in an unprecedented light. Mismanagement of employee health resulted in significant outbreaks of COVID-19 among meatpacking workers in North America and Europe, with working conditions leaving such employees in the US up to 70 times more likely than the general population to contract coronavirus.⁹⁸ The impact on the domestic and global processing and distribution of meat was severe, and lingering concerns over working conditions are still a cause of labour shortages today.⁹⁹

In addition, with many employees coming from groups more vulnerable to human rights abuses,^{100,101,102,103} the issue of workers' rights is an important focus of the Index. Unionisation facilitates constructive dialogue between workers and companies, elevating employees' voices and allowing a business to benefit from the on-the-ground perspective of its workforce. In turn, this can mitigate the risks of high turnover, poor worker satisfaction and other issues. Freedom of association and union representation are also crucial for businesses to mediate conflicts, negotiate agreements, maintain legal compliance and prevent reputational damage. Proper mitigation of these risks contributes to a company's stability.

In alignment with existing frameworks, best practice should see companies disaggregate turnover by seniority, disclose the distribution of workers across all contract types and break down these figures across site locations. By doing this, companies can better identify areas of elevated risk in their supply chains and prioritise these as areas for action.

6.1 Turnover rates

Turnover rates reflect how stable a company's workforce is. A higher turnover can indicate low satisfaction among employees, poor working conditions and a general lack of human capital management.¹⁰⁴ Turnover rates disclosed by Index companies vary from 2% to 68%, and comparisons of such figures necessarily come with limits.

At the most basic level, companies disclose a single turnover rate figure that applies to all workforce departments. Some may break down rates by seniority, age, gender and region. Some companies may disclose both a voluntary and an involuntary turnover rate, while others may disclose only the voluntary rate or not separate the two. Turnover rate should therefore be considered in conjunction with other factors to determine its utility in understanding whether companies are conducting sound human capital management.

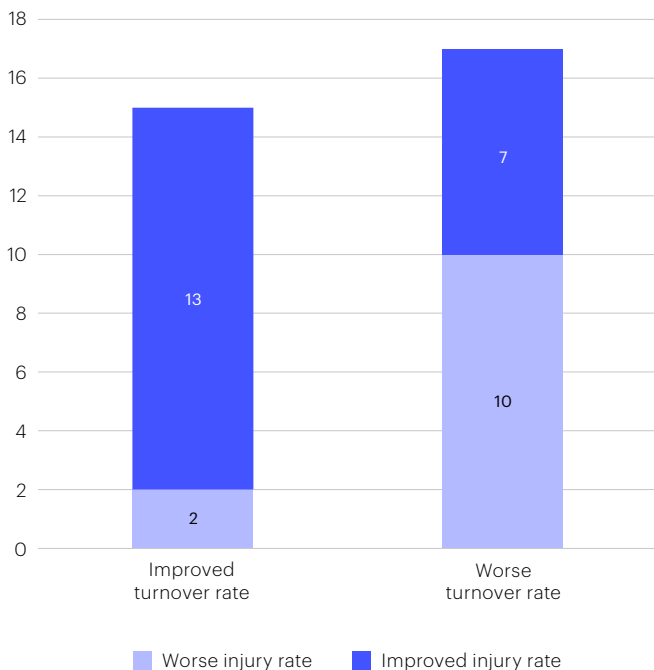
Research shows workers experiencing job-related injuries have lower levels of job satisfaction – as workers with lower levels of job satisfaction are more likely to quit, companies with higher injury rates can see increased turnover.^{105,106} Companies vary in their approaches to reporting injury and fatality rates, such as disclosing a lost time injury rate, a total recordable incidence rate or the number of days lost due to injury, among others. Consequently, the relationship between Index companies' injury rates and turnover rates is worth examining.

The Index's findings show companies with improved injury rates to be more likely to disclose improvements in turnover rates (i.e., the turnover rate has gone down) than those with increased injury rates, as shown in Figure 20. While various factors may explain this pattern, Index data supports the findings of previous studies that link these two topics.



Companies with an improved injury rate are more likely to disclose an improved turnover rate

Figure 20: Changes in turnover rates and injury rates (2022-2023)




It is important to acknowledge that turnover rates in the context of protein producers may not always correlate with a company’s overall social risk level. This is demonstrated by the six Index companies that disclose a turnover rate, show an improvement in turnover and injury rates, have a policy on freedom of association and disclose the percentage of workforce that is unionised.

These companies, listed in Table 11, have an average turnover rate of 26% and a median of 23%. Investors might expect their rates to be lower than those of their peers, considering their high performance across other social risk indicators, but this is not borne out in the data. Excluding these six companies, the average turnover rate is 22% and the median 17%.

Investors should therefore be mindful that the level of turnover disclosed by an Index company may not be an indicator of its level of risk concerning human capital management. In fact, a multitude of factors could determine a company’s turnover rate.

Note: based on 32 companies that reported both changes in injury and turnover rates
Source: FAIRR 2023

Table 11: Working conditions metrics among companies with a reduction in injury rate, turnover rate and freedom of association (FOA)

	Turnover (%)	Injury data (per million hours worked)	Improvement in injury rates	FOA commitment & % of workforce unionised	Improvement in turnover	Expectation or requirement for suppliers to set FOA policy	Temporary workforce (%)
 Marfrig	49	10951 day lost					0
 BAKKAFROST	30	14.88 (a)					0.4
 MAPLE LEAF	41	0.4 (a)					2
 MQWI	15.5	2.3 (d)					8.5
 LERØY	9.5	13.31 (b)					12.5
 MULTI	11	13.03 (c)					13.1

Note: (a) lost recorded incident rate (b) lost time injury (c) lost time frequency rate (d) long-term injury

6.2 Health and safety risks in the value chain

Health and safety is a key area of human capital risk. In the context of protein production, as the table below shows, workers face differing levels of risk, depending on where in a value chain they are employed.



The greatest occupational health and safety risk in livestock supply chains lies in slaughterhouses and processing plants, where workers face a high likelihood of being physically injured due to the use of machinery that can inflict crushing, burning, slicing and amputation.^{107,108} Long hours of repetitive and mentally draining tasks also pose risks to physical and mental wellbeing.¹⁰⁹

In aquaculture, meanwhile, workers employed by feed suppliers tend to face the highest levels of risk. Aquaculture companies use fishmeal and animal trimmings as key feed ingredients, and these are typically produced from wild fish caught on fishing vessels. These workers are exposed to dangerous machinery, hazardous environmental conditions and long working hours and are also highly vulnerable to violation of human rights.^{110,111}

All workers face some degree of risk, but companies and investors should be aware that some are more exposed than others. In turn, steps can be taken to incorporate these varied risks into decision-making.

Table 12: Health and safety risk mapping of protein supply chains

- ▲▲▲▲ Very High Risk
- ▲▲▲ High Risk
- ▲▲ Medium Risk
- ▲ Low Risk

	Farm & hatchery	Slaughter	Processing	Transportation	Feed supply
	▲▲▲	N/A	▲▲	▲▲	▲
	▲▲	▲▲▲▲	▲▲▲	▲	▲
	▲▲	▲▲▲▲	▲▲▲	▲	▲
	▲▲	▲▲▲▲	▲▲▲	▲	▲
	▲▲▲	N/A	▲▲	▲	▲
	▲▲▲	▲▲▲	▲▲	▲	▲▲▲▲

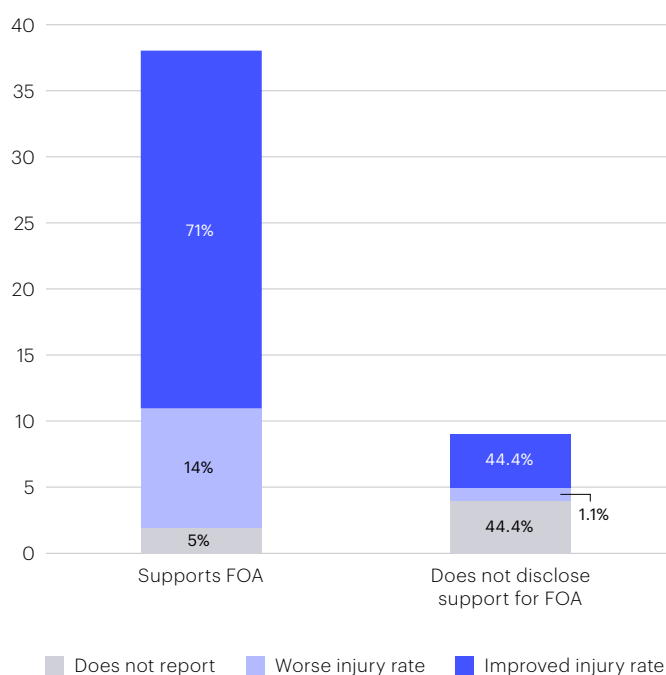
The importance of unions in risk mitigation

One way in which many of the risks discussed in this chapter can be mitigated is to have robust freedom of association systems that allow workers to establish and join unions. These groups are vital in facilitating constructive dialogues between workers and companies and are especially important for workers in low-paying and often hazardous areas such as meatpacking, livestock farming and fishing.

Studies show unionised workforces often experience better physical health, mental wellbeing, wages and productivity than their non-unionised counterparts.^{112,113,114} This is because companies that engage in meaningful

discussions with worker representatives are better able to understand the issues faced by employees and take advantage of the unique, on-the-ground perspective they offer on the business.

Studies show unions’ presence can positively impact occupational health and safety outcomes such as injury and accident rates.¹¹⁵ Reflecting this suggestion, some 71% of Index companies that support freedom of association show an improvement in injury rates – compared with 44% of companies not disclosing support for freedom of association.

Figure 21: Support for FOA vs changes in injury rates^{vii}

Note: Out of 47 companies; companies where FOA is not legally permitted are excluded.

Source: FAIRR 2023

The effectiveness of unions in ensuring adequate working conditions demonstrates why it is also useful for investors to understand whether a company requires its suppliers to support their employees' right to freedom of association. Requiring suppliers to support freedom of association can provide greater transparency with regard to working conditions across a value chain.

The proportion of Index companies that include a requirement or expectation for suppliers to set a policy on freedom of association in their codes of conduct rose from 45% in 2022 to 58% in 2023. It has also gone up year-on-year since 2020. This demonstrates companies increasingly recognise the importance of holding suppliers to standards that can help reduce human capital risks.

Case study: The positive impact of unionisation



Unions' role in holding companies accountable for poor human capital management was recently highlighted by a Brazilian labour union's decision to file a class action lawsuit against JBS for

the exploitation of "chicken catchers".¹¹⁶ The union argues that these workers – employed by a third party – were forced to work long hours with little rest, were not fairly compensated for the hazardous tasks they performed and were exposed to conditions described as "analogous to slavery".¹¹⁷

The lawsuit was filed in July 2023, and the outcome of the case is yet to be determined. Nonetheless, it demonstrates the positive impact unions can have through drawing attention to labour rights issues and generating discussions about employee wellbeing.

Such situations are more likely when companies do not sufficiently monitor their supply chains. JBS states that business associates must abide by various policies – including prohibiting forced labour and human rights abuses – and discloses undergoing a strict auditing process to monitor the risk of forced labour in its cattle supply chain, yet no supplier-monitoring process for its poultry and pork operations is mentioned.

The case underlines that policies alone can often be insufficient to adequately address the social risks in a value chain. Investors and companies are encouraged to consider the scope of a company's audits and monitoring when judging a business's ability to mitigate poor human capital management.

vii Chinese companies as not included here, as they are exempt from supporting freedom of association.

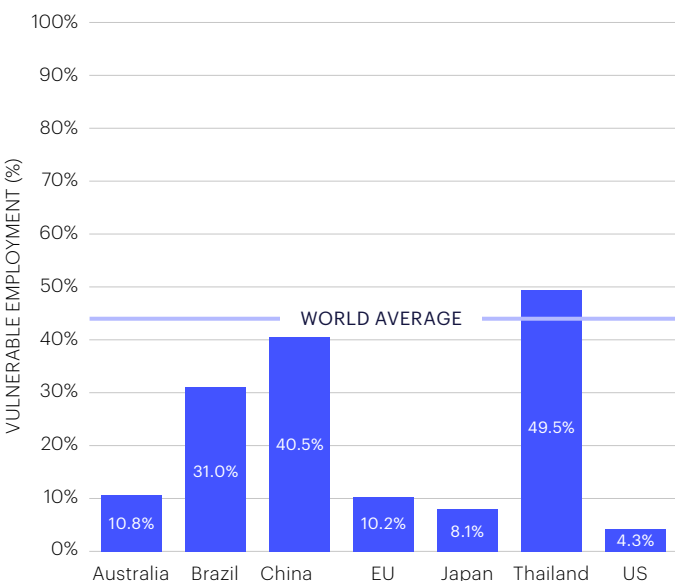
6.3 Fair wages

The topic of fair wages is particularly relevant for Index companies and investors, given low pay throughout the food sector, recent inflationary pressures and the impact of wages on employee wellbeing. The Global Reporting Initiative (GRI) 401 defines fair wages as remuneration that is at least equivalent to the living wage in the region where the recipient is employed.¹¹⁸ According to the UN Global Compact, a living wage is one that allows employees and their families to meet basic needs.¹¹⁹

Studies have shown companies committed to paying a living wage experience lower turnover rates and greater self-reported “affective commitment” among employees.¹²⁰ In turn, these benefits can reduce the financial costs associated with high turnover rates and new employee training.¹²¹ Living wage commitments can also lead to lower absenteeism, higher-quality work and increased productivity.^{122,123}

Historically, most workers in the food production system have been paid wages close to national minimums.¹²⁴ Moreover, vulnerable employment – defined as “the sum of the employment status groups of own account workers and contributing family workers”¹²⁵ – is high in some of the key areas in which Index companies are based, especially China, Brazil and Thailand.

Figure 22: Share of vulnerable employment as percentage of total employment in 2021



Source: FAIRR 2023

Migrant workers are notably likely to receive poor pay. They are often paid less than the minimum wage required to meet basic needs.^{126,127} Such workers are prevalent both in the sector and across Index companies.¹²⁸

Companies have also found themselves in the spotlight for their use of child labour. For example, JBS USA recently ended contracts with a cleaning company fined for hiring children as young as 13 to clean meatpacking plants¹²⁹.

The workers on fishing vessels that operate throughout aquaculture supply chains comprise another vulnerable group. Studies have shown they are often required – and sometimes even forced – to work long hours in return for minimal pay.¹³⁰

More generally, the impact of inflationary pressures on the global economy underscores the importance of a fair wage. The average global inflation rate more than doubled, from 3.2% to 7%, between 2020 and 2023 – peaking at 8.7% in 2022.¹³¹ Real wages fell by 0.9% in the first half of 2022, according to the International Labour Organization’s Global Wage Report 2022-2023, with advanced G20 countries experiencing a 2.2% decrease.¹³² Inflation has made it increasingly difficult for those on the lowest wages to meet their own basic needs and those of their families.¹³³

Committing to paying a fair wage in line with the cost of living should ultimately lead to higher employee retention among protein producers, allowing them to mitigate risks around labour shortages. This is especially important in North America and the UK, where such problems are rampant.¹³⁴ Even in regions with relatively few labour shortages, there is a wealth of evidence indicating fair wages can lead to a more satisfied and productive workforce – potentially improving a company’s bottom line and overall financial performance.



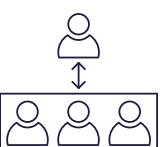


A closer look at fair wages among Index companies

Many companies in this year’s Index stated they provide fair wages by ensuring no workers are paid less than the national minimum wage. However, minimum wage laws do not always guarantee people have sufficient income to meet their basic needs. This is why companies are encouraged to undertake an evaluation of whether the wages they pay genuinely equate to a living wage. Seven Index companies explicitly mentioned a commitment to a living wage, with four of these disclosing undergoing a living wage assessment to ensure workers are paid fairly.

Thai Union and Salmones Camanchaca have particularly extensive disclosure on such assessments. They both use the living wage benchmark from the Global Living Wage Coalition to calculate fair wages, and Thai Union also considers input from worker representatives and conducts its own internal assessment – covering 94% of operations and applying to all employees, irrespective of contract type. However, clear data regarding the outcome of both companies’ assessments is unavailable.

Table 13: Actions taken by companies to ensure a fair wage

	Fair wage measures	Companies
	State a commitment to paying workers a living wage	Bakkafrost, Itoham, Multi X, Mowi, Salmones, Thai Union, Vital Farms
	Conduct living wage assessment	Multi X, Salmones, Thai Union, Vital Farms
	Use external living wage benchmarks, such as the Global Living Wage Coalition	Thai Union, Salmones
	Conducts dialogue with worker representation groups	Thai Union

6.4 In summary

Turnover rates can significantly impact a company’s financial performance and overall stability. Such risks can be mitigated with better performance in relation to health and safety management. However, as turnover rates and health and safety metrics are not standardised across the industry, investors may need to hone in on trends rather than absolute value.

Various human capital risks exist within the value chain of protein production. Especially high risks can be found in the process of slaughtering and on fishing vessels for aquaculture companies. These areas are prone to health and safety risks and the violation of fundamental human rights.

One way companies can mitigate these risks is to have a sound commitment to freedom of association. This supports unionisation. Index data echoes existing studies in showing how companies with unionised operations demonstrate health and safety metrics improvements.

Providing fair wages offers another way of enhancing employee retention. Best practice includes using external living wage benchmarks, consulting with employee representation groups and disclosing outcomes of fair wage exercises. Companies that prioritise fair wages may be better positioned to mitigate operational and reputational risks, in turn positively impacting investor confidence.

7. Concluding remarks

The Collier FAIRR Protein Producer Index has come a long way since its inception in 2018, evolving into a powerful tool for assessing and enhancing the ESG performance of major protein producers. The Index provides unique and granular data for FAIRR's investor members, acting as the food sector's only comprehensive ESG benchmark. In just a few years it has played a pivotal role in engaging companies, driving improvements and mobilising investors towards sustainable practices.

One of the Index's standout achievements is the decrease in the number of companies rated High Risk. The proportion dropped from 55% in 2022 to 45% in 2023, despite a raising of the bar in terms of what constitutes best practice. This is a testament to the Index's impact in encouraging companies to prioritise sustainability and adopt measures to address identified risks.

As the different chapters of this report have shown, regulation, disclosure requirements, public sentiment and consumer preferences on sustainable practices continue to evolve. Companies must be ready to deal with increased attention on these issues.

More broadly, companies need to keep building on the progress made to date, accelerating their sustainability efforts and ensuring they are "walking the talk". In tandem, investors have to continue prioritising ESG factors and engaging in detailed and action-oriented dialogues that help prepare companies for change.

A consistent lesson of the Collier FAIRR Protein Producer Index's findings is that all stakeholders must work collaboratively towards a more sustainable and responsible future for the food sector. The challenges are significant, but the opportunities for positive impact and resilience are even greater.



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