

Tackling the Climate-Nature Nexus

Climate and nature solutions for sustainable livestock production

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Contents

About this report

This report illustrates the environmental and financial impacts of livestock production across the planetary boundaries. It discusses the need for a holistic approach to comprehensively address environmental and financial risks using an integrated framework that accounts for synergies and trade-offs in climate and nature transition plans. The report assesses on-farm solutions by comparing their climate reductions, removal potentials, nature abatement, costs and feasibility of implementation.

The aim of the report is to support investors to better assess the effectiveness of different climate and nature solutions, guide engagement with portfolio companies on adopting solutions, and highlight the need for capital allocation to help drive the transition towards a net-zero and nature-positive future.

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1. Introduction

1.1 Livestock's footprint on climate and nature

Livestock production is a significant contributor to climate change, accounting for up to 11.1-19.6% of global greenhouse gas emissions¹. Around 80% of these emissions occur upstream in the production process, which includes stages such as agrochemical production, animal feed production and the rearing and management of animals (see Figure 1)². Enteric fermentation and associated methane emissions from ruminant livestock production such as beef and dairy are the largest sources of emissions, but nitrous oxide and carbon dioxide emissions from animal feed production, manure management and land use change are also important contributors.

Livestock production also impacts key drivers of nature loss, such as changes in land use, resource overexploitation, species composition and pollution (see Figure 1). For example, expanding pastureland and animal feed production for livestock is the single largest driver of land use change, leading to deforestation and associated biodiversity loss.³ Other key drivers of biodiversity loss from livestock production include nitrogen and phosphorus runoff, impacting water bodies, and the use of harmful pesticides and medically important antibiotics leaching into surrounding ecosystems, deteriorating natural habitats.^{4,5,6}

ⁱ Despite the variation in estimates related to livestock's specific contribution to climate, reducing livestock emissions is vital since even the lower boundary of 11.1% puts livestock as the second largest emitting source globally, only behind energy production and consumption.

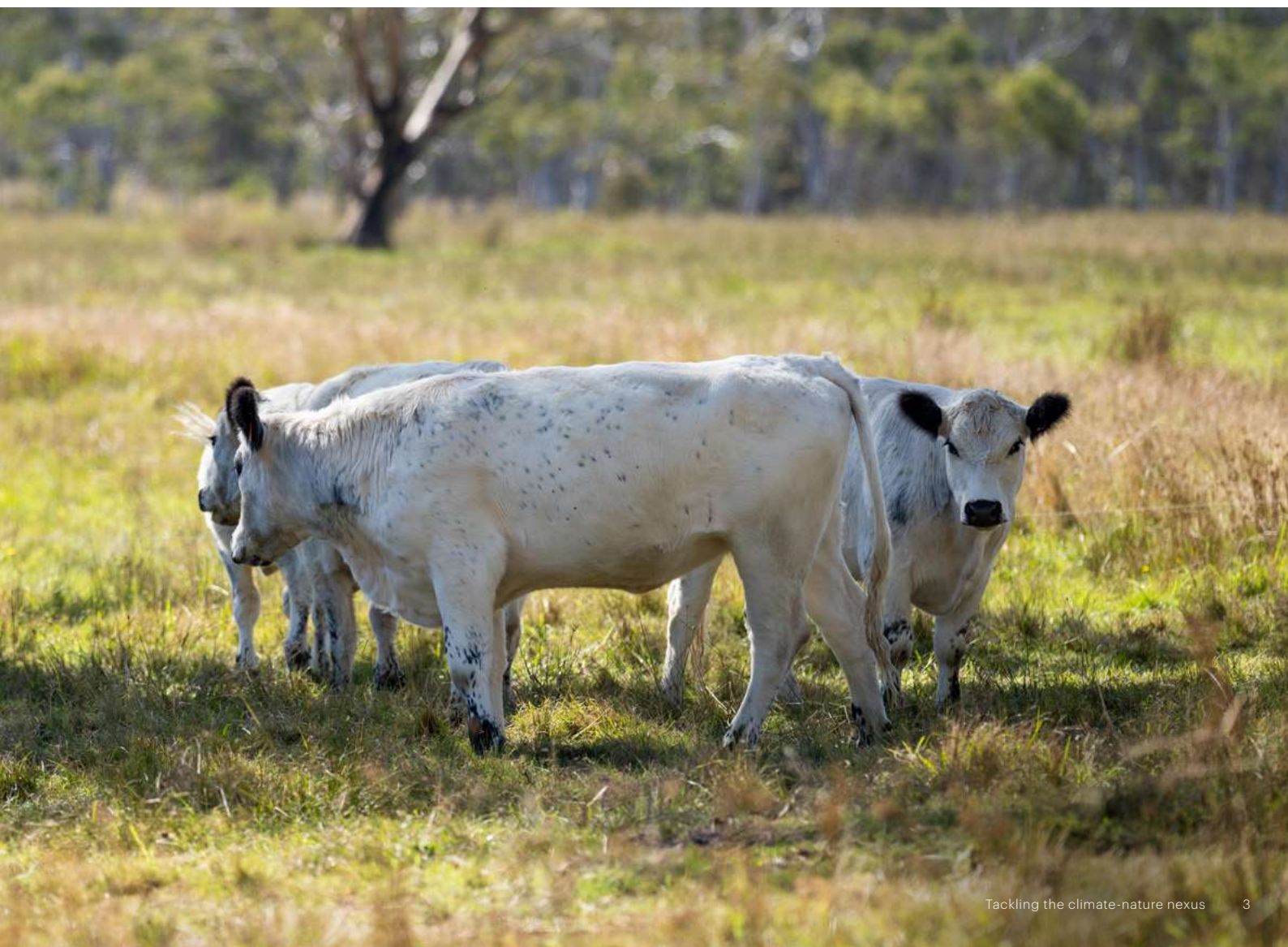
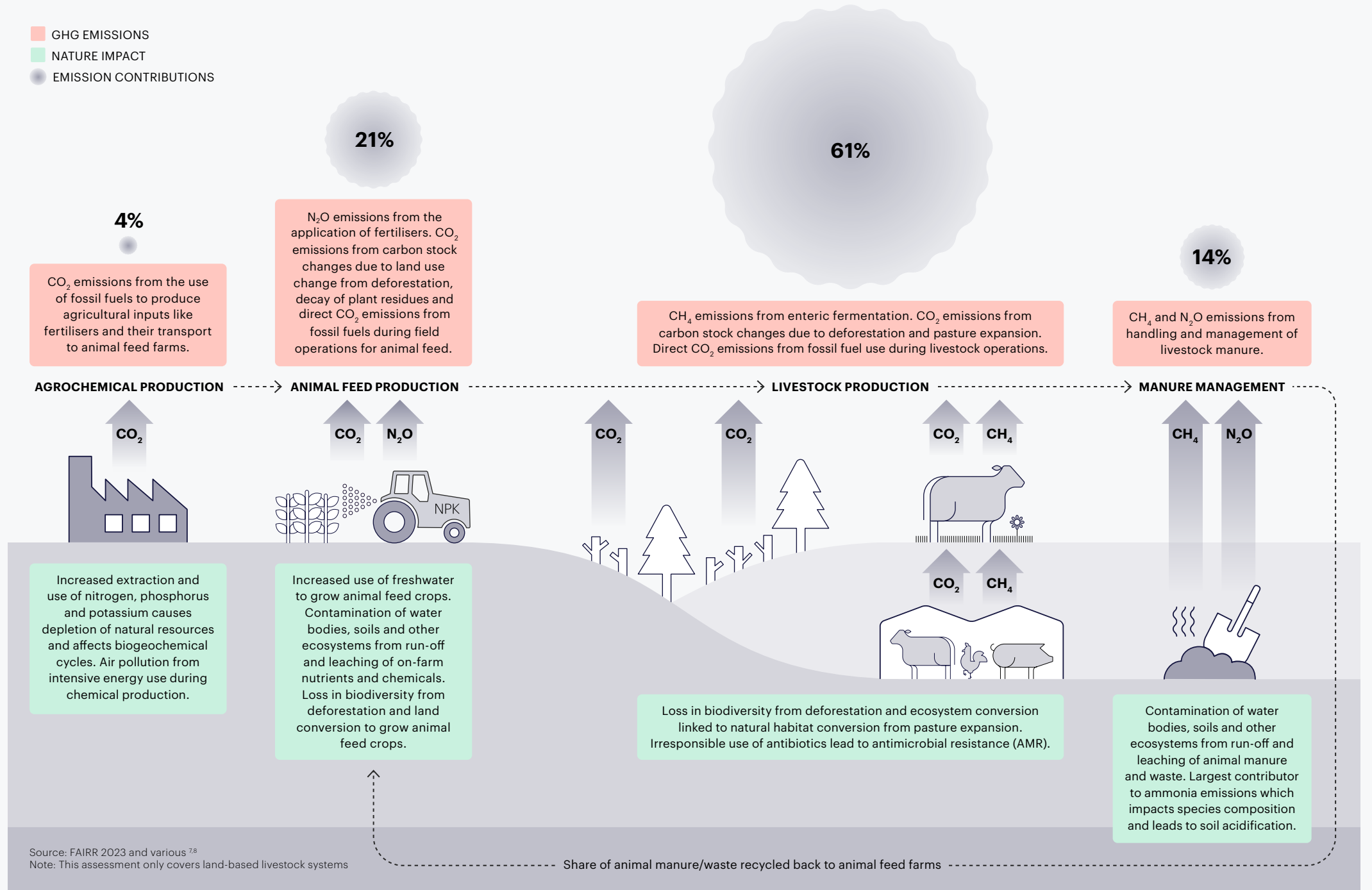


Figure 1: Upstream climate and nature impacts of the livestock supply chain

- GHG EMISSIONS
- NATURE IMPACT
- EMISSION CONTRIBUTIONS



1.2 Livestock sector's impact on the planetary boundaries

The planetary boundaries concept developed by the Stockholm Resilience Centre serves as a useful framework for tracking and communicating the impact of human activities on various environmental factors, including climate and nature.⁹ A recent update of the planetary boundaries reveals that six of the nine boundaries have been breached, which could lead to irreversible damage to the planet's ecosystem.¹⁰

Considering its dependence and impacts on climate and nature, livestock production significantly contributes to the world crossing the safe operating space for the planetary boundaries. Given the ability of the planetary boundaries framework to effectively capture and communicate climate and nature impacts simultaneously, this report uses it to illustrate environmental risks, financial materiality and commitments related to climate and nature associated with livestock production systems.

Figure 2: The 2023 updated planetary boundaries

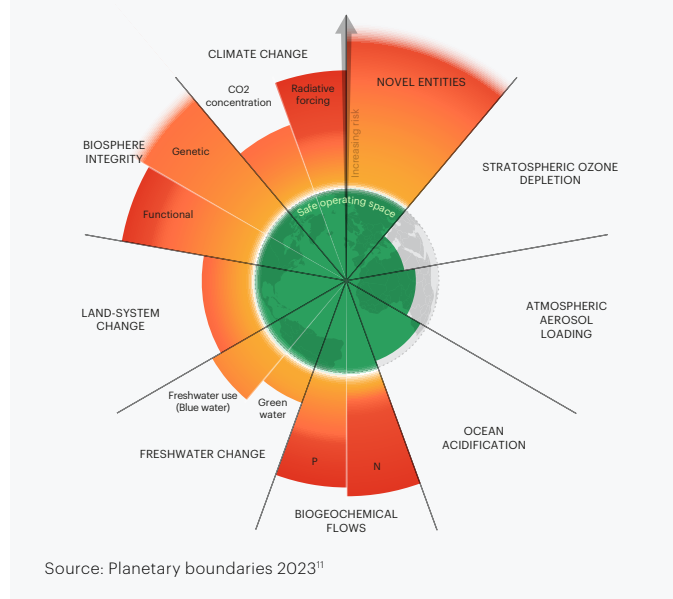









Table 1: Planetary boundaries and their explanations










Planetary boundary	Explanation of boundary
 Climate Change	Increase in greenhouse gas emissions, aerosols and surface albedo causing the climate to change.
 Biosphere Integrity	Loss in genetic and functional diversity of life impacting Earth's ability to regulate its system and be adaptive as a biosphere.
 Land System Change	Conversion of key biomes which play an integral part in the Earth's geophysical processes.
 Freshwater Change	Anthropogenic changes to the water cycle in both blue water (surface and groundwater) and green water (root soil moisture available to plants).
 Biogeochemical Flows	Anthropogenic release of nitrogen and phosphorus that alter natural nutrient flows.
 Novel Entities	Introduction of new entities into the Earth system such as synthetic chemicals, radioactive materials, and human interventions.
 Ocean Acidification	Reduction in pH of the ocean over an extended period of time. Primarily driven by an increase in CO ₂ in the atmosphere.
 Stratospheric Ozone Depletion	Release of halocarbon compounds from human activities causing atmospheric ozone depletion.
 Atmospheric Aerosol Loading	Increased suspension of particles of dust, mists, fumes or smoke that affect the Earth's system.

1.3 Sectoral targets to address climate and nature risks

In the last decade, the climate impact of livestock production has become widely recognised by investors, corporations, policymakers and broader civil society. Although livestock production's impact on nature has only been recently recognised, the urgent need to mitigate these impacts from escalating further is now more widely understood.ⁱⁱ

This has resulted in various targets and commitments to bring the world within a safe operating space for climate and nature. Table 2 summarises some of these commitments against the planetary boundaries framework. Despite nature only receiving recent attention, specific commitments within the Global Biodiversity Framework (GBF) and Science-based Targets for Nature (SBTN) that address nature-related impacts are more immediate and pressing than climate.

Table 2: Table of targets and commitments related to climate and nature mapped to the planetary boundaries

Planetary boundary	Framework	Target	Base Year	Timeframe
 Climate Change	Paris agreement	45%	2016	2030
	Paris agreement	100%	2016	2050
	SBTi FLAG	-12 GtCO ₂ e/y	2022	2050
 Biosphere Integrity	GBF (Target 1 & 4)	~100%	2022	2030
 Land System Change	SBTi FLAG	100%	2022	2025
	GBF (Target 2 & 3)	30%	2022	2030
	SBTN	100%	2020	2025-2030
	SBTN	10%	Variable	2025-2030
 Freshwater Change	SBTN	Variable	Variable	5 years from base year
	GBF (Target 2 & 3)	30%	2022	2030
 Biogeochemical Flows	GBF (Target 7)	50%	2022	2030
	SBTN	Variable	Variable	5 years from base year
 Novel Entities	GBF (Target 7)	50%	2022	2030
 Ocean Acidification	GBF (Target 8)	Minimise	2022	2030
 Stratospheric Ozone Depletion	N/A	N/A	N/A	N/A
 Atmospheric Aerosol Loading	N/A	N/A	N/A	N/A

Source: FAIRR 2023 and various^{2,13,14,15,16}

Note: Indicates important commitments related to climate and nature mapped to the planetary boundaries. This is not an exhaustive list.










ii Adoption of the Kunming-Montreal Global Biodiversity Framework (GBF) during COP15 in 2022 and the release of The Taskforce on Nature-related Financial Disclosures (TNFD) in 2023.

1.4 Financial materiality of exceeding the planetary boundaries

The negative feedback loops of exceeding the planetary boundaries have already resulted in a range of financially material impacts for the livestock sector and the agri-food

value chain. At a macro-level, climate-related risks of the food system were valued at around USD \$1.5 trillion in 2018, and this is even higher for nature at USD \$1.7 trillion.¹⁷ Specific examples of the financial implications of crossing the planetary boundaries for livestock production are reported in Table 3.

Table 3: Financial materiality of livestock sector exceeding the planetary boundaries

Planetary boundary	Financial materiality
 <p>Climate Change</p>	Climate-driven impacts such as heat stress on livestock and yield decline in animal feed are projected to result in cumulative losses of USD \$1.3 trillion by 2030 for 40 of the largest livestock companies.
 <p>Biosphere Integrity</p>	In the Himalayas and Central Asia, the economic value of ecosystem service provision to livestock production was valued at approximately USD \$19.3 million per year.
 <p>Land System Change</p>	Deforestation in the Amazon and Cerrado, exposing soy production to extreme heat, has resulted in revenue losses of approximately USD \$71.6 billion between 1985 and 2012.
 <p>Freshwater Change</p>	Droughts in Argentina impacted pasture quality and reduced beef herd sizes, leading to a decline in the value of Argentinian beef exports by USD \$63 million in early 2023 relative to 2022.
 <p>Biogeochemical Flows</p>	Algal blooms from agricultural run-offs cause reduced oxygen levels in fish farms, resulting in increased fish mortality. In a particular company case study, this led to losses in revenue by 5%, equivalent to USD \$15 million.
 <p>Novel Entities</p>	Antimicrobial resistance-linked infections could lead to a decline in livestock production in low-income countries, resulting in combined losses of USD \$2.1 billion for the beef sector.
 <p>Ocean Acidification</p>	Ocean acidification led to losses of USD \$110 million for the US Pacific Northwest oyster industry between 2005-2009.
 <p>Stratospheric Ozone Depletion</p>	Planetary boundaries beyond farm-to-gate impacts were not analysed.
 <p>Atmospheric Aerosol Loading</p>	Planetary boundaries beyond farm-to-gate impacts were not analysed.

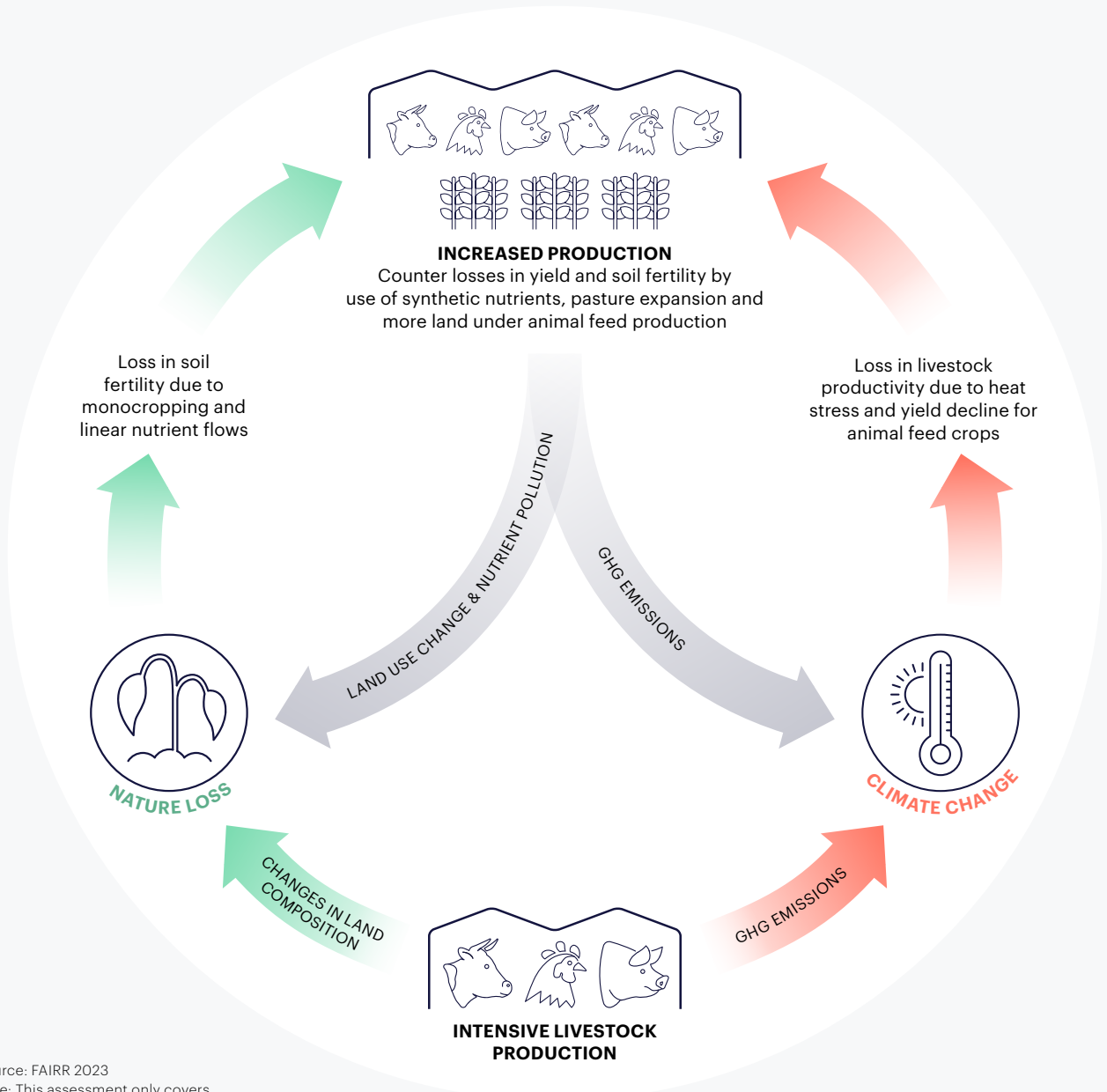
Source: FAIRR 2023 and various^{18,19,20,21,22,23,24,25,26,27,28}

1.5 Climate-nature nexus within livestock systems

The impacts of livestock production are compounded by the interconnectedness between climate and nature. This is evident within livestock production systems (see Figure 3), where the biophysical dynamics, such as increased greenhouse gas emissions and nature loss, are interconnected and lead to impacts that are mutually reinforcing. Ignoring this interconnectedness could lead to compounding financial risks, given that nature-related risks can drive climate risks and vice versa. This interconnectedness also impacts the effectiveness of solutions to deliver climate and nature goals.

For example, solutions that promote intensification of livestock production may have climate benefits from increased efficiency but will lead to detrimental biodiversity impacts due to loss of ecosystem services from demand for animal feed, loss in soil quality from reduced grazing, and increased use of antibiotics, amongst others. Additionally, from a mitigation perspective, analysis of climate targets reveals that nature-based solutions can provide 37% of mitigation required to meet 2030 climate targets.²⁹ This forces investors, policymakers and companies to think beyond siloed sustainability strategies and transition plans that focus on singular issues, towards integrated approaches, to capitalise on the synergies and avoid trade-offs between climate and nature.

Figure 3: Climate-nature nexus within livestock production systems



Source: FAIRR 2023
 Note: This assessment only covers land-based livestock systems

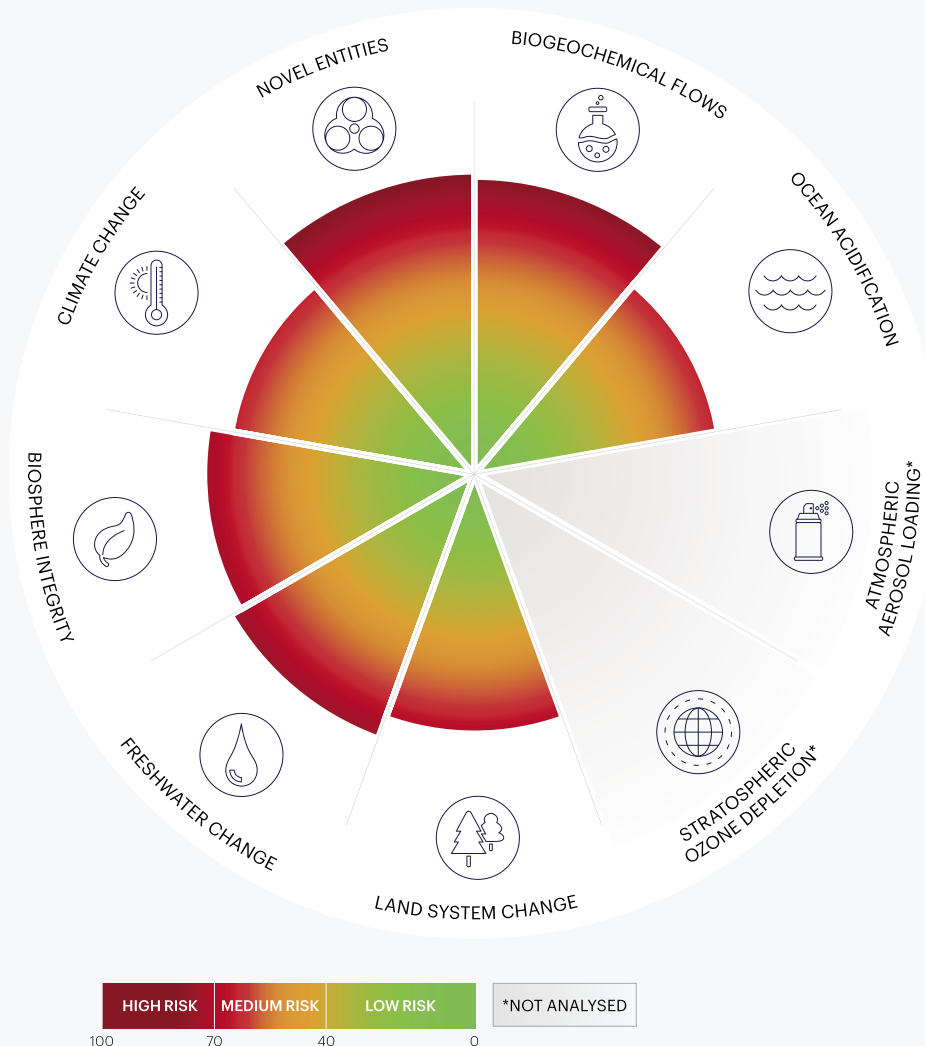
2. State of climate and nature within the livestock industry

2.1 Assessing environmental risks of the livestock industry

An assessment of the climate and nature-related disclosures of livestock companies can help establish a benchmark of how the industry handles risks, sets targets and implements action plans. Figure 4 provides a snapshot of the livestock industry's sustainability risks against the planetary boundaries.

This proxy analysis was carried out by mapping the risk factors from the Collier FAIRR Protein Producer Index (the Index)ⁱⁱⁱ against the planetary boundaries. The Index reports against these risk factors by assessing the corporate ESG disclosures of 60 of the largest livestock producers with a combined revenue of over USD \$522 billion (in 2022). The analysis reveals a similar relationship to the original planetary boundaries results, with nature-related impacts deemed high-risk, while climate is considered medium-risk.

Figure 4: Mapping the Index company risk factors against the planetary boundaries



Source: FAIRR 2023 and The Planetary Boundaries 2023³⁰

Note: The assessment was carried out by mapping the relevant risk factors from the Index against corresponding planetary boundaries. Planetary boundaries have been mapped against the following factors in the Index: climate change, deforestation and biodiversity, water use and scarcity, waste and pollution, and antibiotics. The Index factors assessing animal welfare, working conditions, food safety, governance and alternative proteins were excluded from the analysis.

iii FAIRR. Collier FAIRR Protein Producer Index. 2023. Available at: <https://www.fairr.org/tools/protein-producer-index>

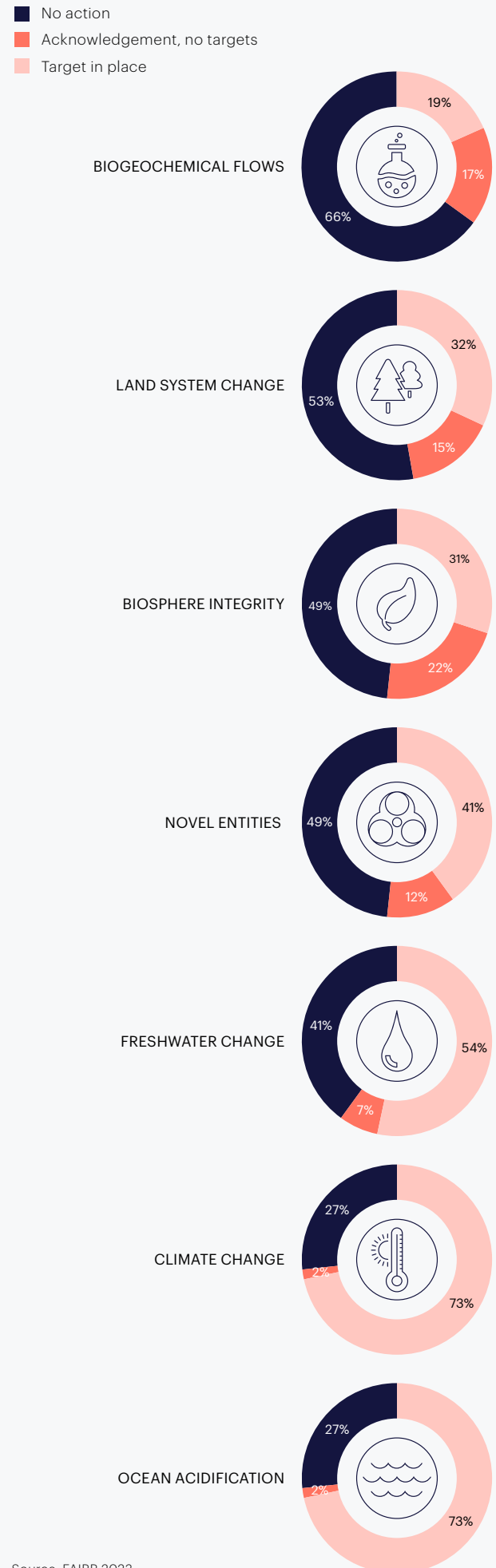
A high-risk classification, as per the Index, is indicative of poor performance with no or limited disclosures, commitments, and action plans. This is reflected in high-risk categorisations for nature-related planetary boundaries such as novel entities, biogeochemical flows, freshwater change, and biosphere integrity.

As observed from the Index, these nature-related impacts remain high due to the significant contribution of livestock production on key biodiversity drivers and the relative inaction from livestock companies in setting targets, addressing risks and identifying mitigation opportunities. A medium-risk classification indicates that some steps have been taken towards risk management, partial disclosure of performance metrics, implementing action plans and setting limited targets. This is indicative of the current climate performance within livestock production as a result of rising commitments and adoption of emission abatement measures, which is reflected in company disclosures.

Figure 5 illustrates specific commitments from the livestock sector against the planetary boundaries using the Index based on a similar mapping as in Figure 4. The figure shows the relatively higher disclosure of climate commitments compared to nature. Given the interconnectedness between climate and nature, the lack of commitments to address nature-related risks can lead to severe climate and nature impacts.

Livestock production is a significant contributor to the world exceeding the safe operating space of the planetary boundaries

Figure 5: Breakdown of the type of commitments by the Index companies against the planetary boundaries



Source: FAIRR 2023

3. Navigating the climate-nature nexus

3.1 The need for climate and nature solutions

Solutions that drive emission reductions and removals within livestock production are critical to a net zero transition. Moreover, given the rise of nature-related targets and commitments (see Table 2), investors with exposure to livestock companies will also need to incorporate nature into their transition plans. The frameworks to understand the impact of nature-related risks to investor portfolios are developing, but investors also need to engage and invest in nature-related opportunities simultaneously. Climate and nature solutions will play a major part in the development of transition roadmaps to align investor portfolios with a net-zero and nature-positive future. Given that the bulk of the livestock emissions and biodiversity impacts occur on-farm, these solutions will need to be focussed at the farm-level to mitigate risks and meet climate and nature targets.

3.2 Identifying climate and nature solutions

Investors already have a good understanding of research and frameworks related to climate risk assessments, and nature-related risk disclosures are on the rise. However, when it comes to understanding the effectiveness and viability of solutions companies are adopting, there is considerably less clarity on what good looks like. For example, when solutions are referenced in public reporting, these are often discussed without much detail. Information on the climate and nature mitigation potential of different solutions, costs, feasibility, the social impact of implementation, etc., are rarely discussed. Further, there is a lack of clarity on why certain solutions are selected and prioritised.

Given the interconnectedness between climate and nature, it is important to understand the impact and potential of these solutions to account for synergies and trade-offs. Figure 6 provides a list of key solutions within the livestock sector that can address climate and nature impacts, along with their interdependencies and implications on social, economic and implementation factors. They are classified as nature-based and non-nature-based solutions. Non-nature-based solutions are engineered solutions with a technological leaning, whereas nature-based solutions leverage the earth's natural capital to minimise risks and deliver social and environmental benefits. Some of the nature-based solutions fall under the spectrum of regenerative agriculture and could be classified as such.

However, for the purposes of this report, which aims to highlight synergies and trade-offs and guide capital allocation decisions towards promising solutions, there is a need to dive deeper into the specific practices that constitute regenerative agriculture. This assessment provides much-needed specificity on both nature and non-nature-based solutions that allow investors to better understand the range of climate and nature solutions available, their abatement potentials, interdependencies, and feasibility. This is useful in supporting dialogues with portfolio companies on incorporating and prioritising solutions within climate and nature transition plans. It can also be helpful to lending practices and asset allocation in scaling up impactful climate and nature-based solutions.

3.3 Potential of nature-based solutions

Over half of the world's GDP is moderately or highly dependent on nature. The agri-food sector is ranked as the most nature-dependent, with a valuation of around USD \$4 trillion.³¹ This has sparked interest from investors, with recent results from the Pollination Group showing that around 50% of the 557 investors surveyed^{iv} had investments in nature-based solutions and nature markets.³²

The benefits from engaging in and deploying capital towards nature-based solutions are manifold. For instance, Figure 6 highlights the dual benefit of nature-based solutions not only in reducing emissions but also contributing to carbon removals within livestock production systems. This makes nature-based solutions an integral element in livestock decarbonisation since both emission reductions and removals are key to meeting near and long-term climate targets. In addition, nature-based solutions have significant co-benefits on nature and social pillars.

Climate and nature solutions are integral in aligning investor portfolios with a net-zero and nature-positive future

iv Pollination group surveyed a sample of 557 investors comprising of different investor types from across the globe. The assets under management (AUM) ranged between USD \$10 billion to more than USD \$500 billion.

Even though mitigation options solely focussing on climate could have an impact on nature, given the primary focus of nature-based solutions on different biodiversity drivers, they have a higher impact on reducing nature-related risks. Considering the poor performance of the livestock industry in addressing nature-related risks, nature-based solutions represent a huge opportunity to directly address these impacts and mitigate climate change.

3.4 Barriers to adopting solutions

Identifying solutions and evaluating their potential to mitigate climate and nature-related impacts is a challenge when allocating capital. However, additional factors such as the costs, scalability and readiness of these solutions are also key parameters that need to be assessed along with their climate and nature mitigation potential.

Our findings reveal mixed results between technology-oriented, non-nature-based solutions and nature-based solutions when it comes to these factors. Some non-nature-based solutions, like anaerobic digesters, require substantial capital investments and might not be commercially feasible across different geographies and livestock production systems, particularly in the developing and underdeveloped parts of the world. Whereas certain nature-based practices like cover cropping and bio-based fertilisers have a lower cost and can be easily integrated into current production systems, delivering positive environmental and economic benefits.

Nature-based solutions can provide 37% of mitigation required to meet 2030 climate targets

However, other nature-based solutions, which represent a significant paradigm shift from conventional production practices, for instance, silvopastoral systems that combine trees and livestock grazing relative to intensive confined livestock production, might pose a challenge. Given that we cannot meet our environmental goals without climate and nature-based solutions, there needs to be a wider discussion to understand and differentiate between types of solutions to inform how priorities must be balanced between solutions for intensification versus nature-based solutions that are transformational and generally expansive. This also opens up discussions across the livestock value chain on the demand-side changes that need to be made, be it a change in protein consumption^v or a reduction of food loss and waste that needs to be combined with on-farm solutions discussed in this report.

Finally, as is the case with any strategy that deploys solutions, credibility and concerns over greenwashing is an issue which has been well documented.³³

v FAIRR. Coller FAIRR Alternative Proteins Report. 2023. Available at: <https://www.fairr.org/themes/alternative-proteins>

Figure 6: List of climate and nature-based solutions with synergies and trade-offs

	Climate change (Reductions)	Climate change (Removals)	Nature	Social	Costs	Readiness & Scalability	
N/NATURE-BASED	Animal feed additives	■ ■ ■ □	N/A	■ □ □ □	■ □ □ □	\$	✓
	Biobased amendments	■ □ □ □	■ ■ ■ ■	■ ■ ■ □	■ ■ ■ □	\$	✓
	Cover crops	■ □ □ □	■ □ □ □	■ ■ ■ ■	■ ■ ■ □	\$	✓
	No/low tillage	■ ■ ■ □	■ □ □ □	■ ■ ■ □	■ ■ ■ ■	\$	✓
	Silvopasture	N/A	■ ■ ■ ■	■ ■ ■ □	■ □ □ □	\$	✓
NON-N/NATURE-BASED	Animal feed additives	■ ■ ■ ■	N/A	■ □ □ □	■ □ □ □	\$	✓
	Animal health and performance monitoring	■ ■ ■ □	N/A	■ ■ ■ □	■ □ □ □	\$	✓
	Greenhouse gas-focused breeding & genetic selection	■ ■ ■ □	N/A	N/A	■ □ □ □	\$	✓
	Large scale anaerobic digestors	■ □ □ □	N/A	■ ■ ■ □	■ □ □ □	\$	✓
	Nitrogen and Urease inhibitors	■ ■ ■ □	N/A	■ ■ ■ □	■ □ □ □	\$	✓
	Precision nutrient application	■ ■ ■ □	N/A	■ ■ ■ ■	■ ■ ■ □	\$	✓

IMPACT

High ■ ■ ■ ■
 Medium ■ ■ ■ □
 Low ■ □ □ □

COST

Below \$75/t CO₂e \$
 \$76-150/t CO₂e \$
 \$151-225/t CO₂e \$
 Above \$225/t CO₂e \$

READINESS & SCALABILITY

Significant progress ✓
 Moderate progress ✓
 Some progress ✓
 No/very limited progress ✓

Source: FAIRR 2023 and various (See supporting information for a full list of references)

Note on methodology: The list of solutions collated is based on key solutions referred to by the livestock industry and is not exhaustive. Climate: assessed and classified as reductions and removals based on the million tonnes of CO₂e reduced or sequestered per year. Nature: assessed based on the range and degree of impact across four nature-related planetary boundaries (biogeochemical flows, freshwater change, biosphere integrity and land system change). Social: assessed from a farmer-centric lens based on four factors – absolute direct economic profit, indirect economic profit, resilience to climate and nature disruptions, and impact on productivity. Cost: assessed based on the cost of solutions per tonne of CO₂e reduced/sequestered. Readiness and scalability: assessed based on five factors – state of development/technology, accessibility across geographies, farming systems, extent of in-depth digital literacy or capacity building, and existence of major financial or infrastructure barriers.

4. Investing in climate and nature solutions

4.1 High-level overview of investments in solutions

A recent Climate Policy Initiative (CPI) study indicated that agriculture has traditionally received low investments when it comes to climate mitigation, receiving only 2.5% of total climate finance in 2020.³⁴ The same study mentions that the Agriculture, Forestry, and Other Land Use (AFOLU) sector would need 26 times more annual funding, equalling USD \$423 billion in annual investment by 2030, to align with the low-carbon trajectory.

In addition, the investment gap in nature-based solutions remains exceptionally high. The United Nations Environment Programme (UNEP) has estimated that annual investment into nature-based solutions must reach USD \$737 billion by 2050 to meet the targets set out in the Rio Convention. The report also indicates that 33% of this investment must be directed at solutions that will be implemented at the farm level.³⁵ Despite the urgent need to close this investment gap, financial flows for nature-based solutions continue to be dwarfed by nature-negative activities, which receive 3-7 times more funding.³⁶ These negative financial flows are propagating the degradation of climate and nature. From the policy side, harmful subsidies that incentivise conventional production practices are estimated to cause environmental damages of around USD \$4 to \$6 trillion per year.³⁷

Agriculture and forestry sector need 26 times more funding than current levels, equalling USD \$423 billion by 2030, to align with a low-carbon trajectory

4.2 Investor action on climate and nature solutions

A transition to a net-zero and nature-positive future depends on capital from both public and private markets. On the public side, institutional investors have a key role in scaling up climate and nature solutions through engagement and stewardship activities within their portfolios. In addition, they can also catalyse structured finance to support project developers that deploy solutions and provide equity investments with a certain risk appetite to scale this emerging market.³⁸

On the other hand, private equity can directly fund promising solution providers to support implementation and drive market integration. For example, asset manager Tikehau Capital, along with AXA and Unilever, launched a private equity impact fund, committing around USD \$325 million towards scaling up regenerative agriculture.³⁹

From the lending side, there is some movement in the use of proceeds to incentivise agricultural solutions. For instance, in 2023, green bonds in the agri-food sector represented around 5% of total issued bonds, equalling USD 26.5 billion.⁴⁰ It is expected that the green bonds market will continue to grow, with projections for 2035 ranging from USD \$5 to \$6 trillion.⁴¹ A significant share of this growth would be dedicated to the agri-food sector, including livestock solutions. For example, BPCE (Banque Populaire Caisse d'Épargne), the third-largest banking player in the agricultural sector in France, issued a USD \$810 million green bond in 2022 to refinance sustainable agriculture assets.⁴² To be eligible for a loan, the assets must contribute to the development and/or adoption of sustainable production practices such as pollution prevention and control, water management, climate change mitigation, and protection of biodiversity and natural areas.

There are also some recent developments in real estate investments to capitalise on agricultural solutions. For example, SLM Partners, a global real assets investment manager, invests heavily in sustainable land management practices, which include solutions such as livestock grazing.⁴³ Philanthropic support for decreasing climate and nature impacts through development aid is also on the rise, as seen from the Action Agenda on Regenerative Landscapes agreed during COP28, with investments of USD \$2 billion and commitments of an additional USD \$2.2 billion to collectively scale regenerative agricultural practices across 160 million hectares.⁴⁴

Investors can also play a key role in advocating for a policy environment that allows for greater investment in climate and nature solutions. This could be through involvement in working groups and providing consultation responses on disclosure requirements and taxonomies to better categorise and assess the potential and impact of climate and nature-based solutions. An example of this is the investor statement to the Food and Agricultural Organisation (FAO) led by FAIRR, backed by investors representing USD \$18 trillion in combined assets, which led to the publication of the FAO roadmap for the food and agricultural sector during COP28.⁴⁵ The roadmap provides clarity on the transition pathway with proposed solutions and their contribution towards the transition. Investors can also encourage key policy stakeholders to create a level policy playing field by redirecting economic incentives from activities that lead to negative environmental externalities to ones that deliver positive climate and nature outcomes. For instance, the recent investor statement led by FAIRR, which was backed by investors worth USD \$7 trillion in combined assets, calls on the G20 Finance Ministers to repurpose their agricultural subsidies in line with climate and nature goals.⁴⁶

Annual investments in nature-based solutions must reach USD \$737 billion by 2050 to meet nature targets

The role of investors

Given the climate and nature-related risks and opportunities associated with livestock production, investors with exposure to animal protein companies - including producers, manufacturers, retailers and restaurant chains, will face financial implications unless they take necessary action. As shareholders and debtholders, investors play a key role in helping to reform current production systems to protect and ensure long-term value creation.

- 1 Acknowledging and understanding the impact of livestock production on climate and nature within their portfolios.
- 2 Setting ambitious targets for both climate and nature and ensuring these are reflected and adopted by portfolio companies.
- 3 Integrating climate and nature risks into existing valuation procedures for companies.
- 4 Stewardship and engagement to encourage and support portfolio companies to select holistic and effective solutions to mitigate climate and nature risks to create long-term value.
- 5 Designing, developing, and funding financial instruments to help address risks and capitalise on solutions to support the climate and nature transition.
- 6 Undertaking due diligence on monitoring, verifying claims, reporting progress and the use of proceeds in meeting climate and nature goals.

5. Path forward

This analysis details the contribution of the livestock sector to climate and nature-related risks and highlights the poor performance of the industry in addressing these risks. The onus on solutions is clear in fostering a sustainable transition, but an assessment of the potential of solutions, their interconnectedness with climate and nature and the

feasibility of implementation is still unclear. This assessment deep dives into specific climate and nature-based solutions and evaluates their potential and feasibility. This will allow investors and corporates to identify and prioritise solutions and to ascertain the investment support required to scale up and incentivise the adoption of promising solutions.



References

- 1 Blaustein-Rejto, D., & Gambino, C. (2023, March 20). Livestock Don't Contribute 14.5% of Global Greenhouse Gas Emissions. The Breakthrough Institute. <https://thebreakthrough.org/issues/food-agriculture-environment/livestock-dont-contribute-14-5-of-global-greenhouse-gas-emissions>
- 2 Ritchie, H. (2021, March 18). How much of global greenhouse gas emissions come from food? Our World in Data. <https://ourworldindata.org/greenhouse-gas-emissions-food>
- 3 Ritchie, H. (2021, February 4). Drivers of Deforestation. Our World in Data. <https://ourworldindata.org/drivers-of-deforestation>
- 4 Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F., Lambin, E., Lenton, T., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C., Hughes, T., Van Der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P., Costanza, R., Svedin, U., & Falkenmark, M. (2009). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. <https://www.stockholmresilience.org/download/18.8615c78125078c8d3380002197/ES-2009-3180.pdf>
- 5 Tian, M., He, X., Feng, Y., Wang, W., Chen, H., Gong, M., Liu, D., Clarke, J. L., & van Eede, A. (2021). Pollution by Antibiotics and Antimicrobial Resistance in LiveStock and Poultry Manure in China, and Countermeasures. *Antibiotics* (Basel, Switzerland), 10(5), 539. <https://doi.org/10.3390/antibiotics10050539>
- 6 Sud, M. (2020). Managing the Biodiversity Impacts of Fertiliser and Pesticide Use. In Organisation for Economic Co-operation and Development (OECD). *OECD Environment Working Papers*. [https://one.oecd.org/document/ENV/WKP\(2020\)2/En/pdf](https://one.oecd.org/document/ENV/WKP(2020)2/En/pdf)
- 7 Food and Agriculture Organization of the United Nations. (2015). Livestock emission data at a glance. Shinyapps.io. https://foodandagricultureorganization.shinyapps.io/GLEAMV3_Public/
- 8 Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Faluccci, A., & Tempio, G. (2013). Tackling Climate Change Through Livestock – A Global Assessment of Emissions and Mitigation Opportunities. Food and Agriculture Organization of the United Nations (FAO). <https://www.fao.org/3/i3437e/i3437e.pdf>
- 9 Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., Bloh, W. von, Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Bravo, D., & Petri, S. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37). <https://doi.org/10.1126/sciadv.adh2458>
- 10 Ibid.
- 11 Ibid.
- 12 Convention on Biological Diversity. (n.d.). 2030 Targets (with Guidance Notes). [www.cbd.int](https://www.cbd.int/gbftargets). <https://www.cbd.int/gbftargets>
- 13 United Nations. (2023). Net Zero Coalition. United Nations. <https://www.un.org/en/climatechange/net-zero-coalition#:~:text=to%202010%20levels>.
- 14 Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., Bloh, W. von, Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Bravo, D., & Petri, S. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37). <https://doi.org/10.1126/sciadv.adh2458>
- 15 Science Based Targets. (2023). Forest, Land and Agriculture Science-Based Target-Setting Guidance. World Wildlife Fund. <https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf>
- 16 Science Based Targets Network. (2023). Technical Guidance: Step 3 Freshwater: Measure, Set & Disclose. <https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023Step3-Freshwater-v1.pdf>
- 17 The Food and Land Use Coalition. (2019). Growing Better: Ten Critical Transitions to Transform Food and Land Use. <https://www.foodandlandusecoalition.org/wp-content/uploads/2019/09/FOLU-GrowingBetter-GlobalReport-SummaryReport.pdf>
- 18 FAIRR Initiative. (2023). Collier FAIRR Climate Risk Tool: The Financial Impact of Climate Change on the Livestock Sector. In FAIRR.org. FAIRR. <https://go.fairr.org/2023-Collier-FAIRR-Climate-Risk-Tool-Public-Report>
- 19 Flach, R., Abrahão, G., Bryant, B., Scaraballo, M., Soterroni, A. C., Ramos, F. M., Valin, H., Obersteiner, M., & Cohn, A. S. (2021). Conserving the Cerrado and Amazon biomes of Brazil protects the soy economy from damaging warming. *World Development*, 146(105582). <https://doi.org/10.1016/j.worlddev.2021.105582>
- 20 Salmones Camanchaca. (2022). Integrated Annual Report 2021. <https://salmonescamanchaca.cl/en/wp-content/uploads/2022/04/Integrated-Annual-Report-2021-Salmones-Camanchaca-web.pdf>
- 21 World Bank Group. (2017). Drug-Resistant Infections. International Bank for Reconstruction and Development/World Bank Group. <https://documents1.worldbank.org/curated/en/323311493396993758/pdf/final-report.pdf>
- 22 Ekstrom, J. A., Suatoni, L., Cooley, S. R., Pendleton, L. H., Waldbusser, G. G., Cinner, J. E., Ritter, J., Langdon, C., van Hooindonk, R., Gledhill, D., Wellman, K., Beck, M. W., Brander, L. M., Rittschof, D., Doherty, C., Edwards, P. E. T., & Portela, R. (2015). Vulnerability and adaptation of US shellfisheries to ocean acidification. *Nature Climate Change*, 5(3), 207–214. <https://doi.org/10.1038/nclimate2508>
- 23 Murali, R., Ikhagvajav, P., Amankul, V., Jumabay, K., Sharma, K., Bhatnagar, Y. V., Suryawanshi, K., & Mishra, C. (2020). Ecosystem service dependence in livestock and crop-based production systems in Asia's high mountains. *Journal of Arid Environments*, 180(104204). <https://doi.org/10.1016/j.jaridenv.2020.104204>
- 24 Salinas, R. (2023, April 14). Drought in Argentina Led to Increased Beef Output And Depressed Prices and Export Values in Jan-Feb 2023. Tridge; Tridge. <https://www.tridge.com/stories/drought-in-argentina-led-to-increased-beef-output-and-depressed-prices-and-export>
- 25 Hrozencik, A. (2024, January 31). Livestock Forage Disaster Program payments concentrated in the Western and Central United States. www.ers.usda.gov; Economic Research Service. <https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=108414>
- 26 Washington State Blue Ribbon Panel on Ocean Acidification. (2012). *Ocean Acidification: From Knowledge to Action*, Washington State's Strategic Response. In H. Adelman & L. Whitley Binder (Eds.), *ecology.wa.gov*. Washington Department of Ecology. <https://apps.ecology.wa.gov/publications/publications/1201015.pdf>
- 27 FAO. (2023, March 24). *Crops and Livestock Products*. Food and Agriculture Organization of the United Nations. <https://www.fao.org/faostat/en/#data/QCL>
- 28 O'Neill, A. (2024, February 5). Average prices for meat (beef) worldwide from 2014 to 2025. Statista. <https://www.statista.com/statistics/675826/average-prices-meat-beef-worldwide/>
- 29 Eduardo, B., Diaz, S., Settele, J., & Ngo, H. T. (2019). IPBES, 2019. Summary for policy makers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services. *Population and Development Review*, 45(3), 680–681. <https://doi.org/10.1111/padr.12283>
- 30 Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., Bloh, W. von, Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Bravo, D., & Petri, S. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37). <https://doi.org/10.1126/sciadv.adh2458>
- 31 Herweijer, C., Evison, W., Mariam, S., Khatri, A., Albani, M., Semov, A., & Long, E. (2020). Nature risk rising: Why the crisis engulfing nature matters for business and the economy. In World Economic Forum and PwC. http://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf
- 32 Pollination Group (2023). *Nature Finance Focus*. Tracking global trends in nature investment. <https://pollinationgroup.com/nature-finance-focus/>
- 33 FAIRR (2023). *The Four Labours of Regenerative Agriculture*. Paving the way towards meaningful commitments. <https://www.fairr.org/resources/reports/regenerative-agriculture-four-labours>
- 34 Climate Policy Initiative. (2022). *Landscape of Climate Finance for Agriculture, Forestry, other Land Use and Fisheries: Preliminary Findings*. In Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/landscape-of-climate-finance-for-agriculture-forestry-other-land-uses-and-fisheries/>
- 35 United Nations Environment Programme, Global Canopy, & The Economics of Land Degradation Initiative. (2023). *State of Finance for Nature: The Big Nature Turnaround – Repurposing \$7 trillion to combat nature loss*. <https://www.unep.org/resources/state-finance-nature-2023>
- 36 Coalition for Private Investment in Conservation (CPIC). (2023). *Building a Capital Continuum for Nature-Positive Investments*. Coalition for Private Investment in Conservation (CPIC). <https://cpicfinance.com/insight/new-report-towards-building-a-capital-continuum-for-nature-positive-investments/>
- 37 Partha Dasgupta. (2021). *The Economics of biodiversity: the Dasgupta Review*. Abridged Version. London Hm Treasury.
- 38 VividEconomics. (2021). *The Institutional Investor's Guide to Natural Climate Solutions*. In *ceres.org*. <https://www.ceres.org/sites/default/files/210513%20final%20report.pdf>
- 39 AXA. (2022). *Regenerative agriculture transition to be accelerated through new impact strategy from AXA, Unilever and Tikehau Capital*. <https://www.tikehaucapital.com/-/media/Files/T/Tikehau-Capital/pr-2022-en/AXA-Unilever-Tikehau-Capital-PR-11052022.pdf>
- 40 Climate Bonds Initiative. (2023, April 18). *Global State of the Market Report 2022*. Climate Bonds Initiative. <https://www.climatebonds.net/market/data/#use-of-proceeds-charts>
- 41 OECD. (2017). *Mobilising Bond Markets for a Low-Carbon Transition*, Green Finance and Investment, OECD Publishing, Paris. <https://dx.doi.org/10.1787/9789264272323-en>
- 42 Groupe BPCE. (2022, January 6). *Groupe BPCE becomes the first European issuer of green bonds devoted to sustainable agriculture, through a €750m issue enabling the Banque Populaire banks to refinance their assets in the sector*. *Newsroom-En.groupebpce.fr*. <https://newsroom-en.groupebpce.fr/news/groupe-bpce-becomes-the-first-european-issuer-of-green-bonds-devoted-to-sustainable-agriculture-through-a-eur750m-issue-enabling-the-banque-populaire-banks-to-refinance-their-assets-in-the-sector-d7c4-53927.html>
- 43 Wealth Briefing (2022). *Investment in Regenerative Agriculture and Forestry Rising – SLM Partners*. <https://www.wealthbriefing.com/html/article.php?id=195403>
- 44 World Business Council for Sustainable Development (WBCSD). – COP28 Action Agenda on Regenerative Landscapes launched in Dubai. (2023). <https://www.wbcsd.org/Pathways/Food-Agriculture/News/COP28-Action-Agenda-on-Regenerative-Landscapes-launched-in-Dubai>
- 45 FAO. (2023). – FAO COP 28 – Roadmap. <https://www.fao.org/interactive/sdg2roadmap/en/>
- 46 FAIRR. (2023). *G20 Agricultural Subsidies Statement*. <https://www.fairr.org/investor-statements/g20-agricultural-subsidies>

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