



THE POLITICS OF PROTEIN

EXAMINING CLAIMS ABOUT LIVESTOCK, FISH,
'ALTERNATIVE PROTEINS' AND SUSTAINABILITY

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SUMMARY

Animals continue to play a major role in food production systems around the world. Livestock contributes to the livelihoods of 1.7 billion smallholder farmers in the Global South, and plays a crucial economic role for approximately 60% of rural households in developing countries. The sector also employs as many as 4 million people in the EU, where 58% of farms hold animals, including many small and mid-sized holdings. Meanwhile, fisheries and aquaculture provide livelihoods for nearly 60 million people worldwide, and more than 3 billion people rely on fish as a primary source of protein. For a number of populations around the world, however, diets remain primarily based on pulses, grains, and other plant-based foods, with minimal consumption of animal source foods.

Animal production systems have expanded and changed dramatically over recent decades, with major impacts on food systems in all regions. Globally, per capita consumption of meat and fish nearly doubled between 1961 and 2015, driven primarily by the Global North, and more recently by increasing consumption in developing countries. The livestock sector now represents 40-50% of global agricultural GDP, and is increasingly characterized by vast multinational firms with huge market share and political clout. By 2014, the world's top 10 meat processing companies controlled 75% of beef slaughter, 70% of pork slaughter, and 53% of chicken slaughter. And by 2018, seven firms dominated poultry, pigs, cattle, and aquaculture genetics, and made over \$80 billion in sales.

Industrial meat and dairy companies are now expanding into multiple animal source food sectors in order to tap growth opportunities. This 'protein convergence' involves the majority of dominant meat processors in the world – including JBS, Tyson, WH Group, and Cargill. Most of the largest meat processing firms now have poultry, pork, and beef divisions, and the biggest fisheries firms have expanded into salmon aquaculture.

Nearly every large meat and dairy processor/manufacture has also acquired or developed plant-based meat and

dairy substitutes, establishing footholds in a market that is growing approximately 20% per year. More than a dozen of these firms have also invested in start-ups that are attempting to commercialize lab-grown meat and fish. Meanwhile, Vanguard and BlackRock – two of the world's biggest asset management firms – have investments in almost all the largest meat, dairy, and animal feed companies.

These developments are taking place in a context of unprecedented scrutiny of animal source foods. With 'planetary boundaries' being crossed, the climate crisis accelerating, and threats to food security and human health mounting by the day, *meat* and *protein* have come firmly under the microscope. As production systems have scaled and industrialized in many world regions, their impacts on animals, people, and the planet have grown. The FAO considers that livestock accounts for 14.5% of global greenhouse gas (GHG) emissions, while some estimates put the figure above 30%. More than 60% of human infectious diseases are caused by pathogens shared with wild or domestic animals. Overuse of antibiotics in livestock is a major contributor to infections from antimicrobial resistant pathogens – which are expected to rise 40% by 2050 (from 2014 levels). Unsafe and abusive working conditions are rife, as evidenced by forced labour and human trafficking in marine fisheries, and high rates of COVID-19 infection and fatalities in industrial feedlots and meatpacking plants. In wealthy and emerging countries, over-consumption of meat and dairy is associated with rising rates of obesity and chronic diseases, while the world's poorest populations are unable to access adequate food, with up to 811 million people undernourished in 2021.

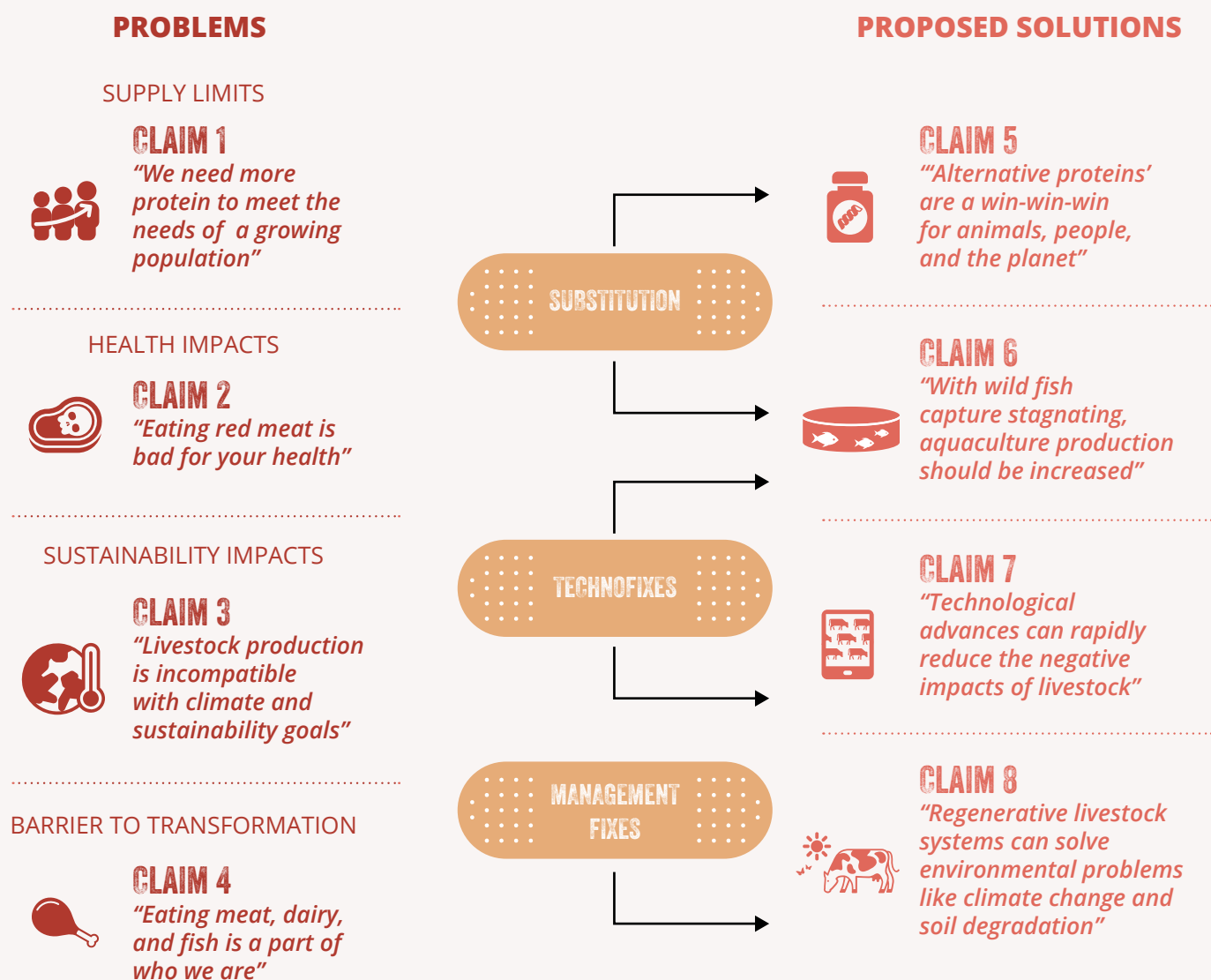
Public awareness of these problems has grown and the urgency of action has been impressed upon governments. It is now beyond doubt that the sustainability challenges we face cannot be met while livestock systems rely on huge quantities of feed crops and continue to occupy nearly 80% of global farmland. There is also broad consensus

on what healthy and sustainable diets generally look like, i.e. diets based on a diversity of nutrient-rich foods, such as vegetables, fruits, whole grains, and pulses, and also including meat, dairy, eggs and/or fish in some regional contexts.

But the way forward is far from clear. Discussion is characterized by bold and conflicting claims, as industry groups, philanthro-capitalists, influential media figures, and many others weigh into the debate. Their claims offer competing visions of what problems need to be addressed, and how they should be solved. And in

increasingly polarized debates, a range of different solutions and different 'protein transitions' are now being demanded – from meat taxes to R&D funding for lab-grown meat, from vegan diets to regenerative agriculture and ocean farming, from precision livestock packages to industrial-scale insect protein. In response, public and private investment is flowing into a range of sectors, with a number of governments developing 'protein' strategies and channeling funds into lab-grown meat and plant-based substitutes. We identified eight key claims that are setting the terms of debate and driving these responses.

EIGHT KEY CLAIMS ABOUT LIVESTOCK, FISH, 'ALTERNATIVE PROTEINS', AND SUSTAINABILITY



Analysis of these claims reveals that misleading statements and over-generalizations are pervasive in debates on meat and protein. A number of claims are widely repeated and accepted as fact, despite being based on uncertain evidence or addressing only certain aspects of the problem. Framing the discussion around these claims narrows the lens in five key ways, leading to simplistic silver bullet solutions:

1 OVEREMPHASIS ON PROTEIN

For decades, the perceived need for more protein has led to distractions and distortions in development programs, flawed marketing and nutritional campaigns, and calls to increase the production and trade of meat, dairy, and protein-enriched foods. Today, the evidence clearly shows that there is no global ‘protein gap’: protein is only one of many nutrients missing in the diets of those suffering from hunger and malnutrition, and insufficiency of these diets is primarily a result of poverty and access. However, debates remain protein-centric, with the focus now on producing enough protein to feed the world in the face of supply constraints and rising demand. In this context, animals are consistently reduced to meat, and meat is reduced to protein. The ‘protein obsession’ is now shaping the political agenda and setting the parameters for scientific studies, media coverage, and public debate, with farming systems assessed primarily (or solely) in terms of protein production per unit of GHG emissions, and the need for a ‘protein transition’ guiding the various solutions on the table.

2 REDUCING SUSTAINABILITY TO GHGs ONLY

Sustainability challenges vis-à-vis animal source foods are often collapsed into a single dimension – GHG emissions, and sometimes just CO₂ or methane – ignoring other critical sustainability challenges like biodiversity loss, chemical pollution, land degradation, livelihood stresses, hunger, and micronutrient deficiencies. Furthermore, by positioning livestock as a barrier to net zero in the land sector, some simplistic claims end up treating all livestock like an extractive industry and ignoring the diversity of production systems and their impacts (positive and negative) on other aspects of sustainability. Although GHGs are less dominant in discussions on fish, sustainability concerns also tend to be expressed in general terms, overlooking the huge differences between aquaculture systems and between different types of fisheries.

3 FAILURE TO CONSIDER HOW FOODS ARE PRODUCED

In many farming communities, animals play multiple roles: they provide food, hides, wool, and traction, help fertilize soils, act as financial collateral, hold cultural

value, and make use of marginal land in a way that brings livelihoods, income, and food security to regions with few alternatives. Huge differences also exist between different models of aquaculture and how they interact with ecosystems and communities, as well as between aquaculture and wild fisheries systems. Yet these barely comparable systems are regularly conflated, with very little discussion of agro-silvo-pastoral systems, multi-paddock grazing, pastoralist systems, integrated multi-trophic aquaculture systems, artisanal fisheries, and other agroecological models. Studies often compare ‘alternative proteins’ against a single (industrial) livestock system on GHG terms. Similarly, plant-based diets are often presented as a singular, standardized option that can be universally adopted in place of meat-based diets, despite the huge differences in impacts depending on how crops are grown and processed.

4 FAILURE TO DIFFERENTIATE BETWEEN WORLD REGIONS

The value of meat as a source of high-quality bioavailable protein and diverse micronutrients for many populations around the world tends to be overlooked, or considered as a secondary question. Pastoralist systems and small-scale artisanal fisheries also tend to be ignored in the universalizing discourse of a ‘protein transition’. From regenerative livestock to ‘alternative proteins’, a number of solutions that are purportedly universal have clearly been envisaged through a Global North lens. The idea that we need *more protein* but *less meat* – as many prominent claims suggest – is out of sync with the realities of food insecurity and livelihood challenges in many parts of the world, particularly in the Global South. Context matters greatly where animal source foods are concerned, and is often lost in current debates.

5 FAILURE TO CONSIDER COMPLEXITIES, PATH DEPENDENCIES, AND POWER DYNAMICS (FAILURE TO SEE THE WHOLE FOOD SYSTEM)

The latest ‘techno-fixes’ for livestock and aquaculture are based on increasing the intensity, uniformity, and density of industrial systems – and are therefore likely to generate further problems down the line, requiring another round of technological innovations in order to preserve productivity gains. Claims about ‘alternative proteins’ also tend to ignore the risks of reinforcing current food system dynamics, such as the reliance of these new technologies on mass-produced, monocultured ingredients and energy-intensive hyper-processing – which will offset many of the benefits of taking factory farms off stream. Furthermore, the potential of various corporate-led solutions to have a positive impact on sustainability, livelihoods, and resilience is severely constrained by the business model of a highly concentrated industrial agri-food sector, which

systematically relies on abusive practices and generates hidden costs or 'externalities'. In other words, these solutions require major shifts in land use, energy systems, economic incentives, and corporate practices in order to deliver benefits. But these same solutions reinforce the power relations that keep current systems in place, and fail to address the question of how systemic changes will be achieved.

Critically, the effect of framing the debate so narrowly is to focus our attention on simplistic silver bullet solutions. Through the lens of protein on one side and GHG emissions on the other, sectors and activities that are barely comparable are set alongside each other, using metrics that are ill-adapted to capture the complex socio-ecological interactions and impacts of livestock, fishery and agricultural systems. Questions of *how* and *where* food is produced are lost in the hype around silver bullet solutions. And when challenges are formulated in such a reductive way, lab-grown meat and novel plant-based substitutes appear to be the most viable solutions. 'Techno-fixes' for industrial feedlots and intensive aquaculture are similarly well-placed to answer such narrowly-defined needs.

Furthermore, **the misleading claims that dominate meat and protein debates prevent consideration of more transformative pathways.** Insufficient attention is paid to diversified agroecological production systems, territorial food chains and markets, and 'food environments' which increase access to healthy and sustainable diets. These pathways respond holistically to challenges whose breadth and depth have been well-evidenced. They entail transformative behavioural and structural shifts. They require *sustainable food system transitions*, not merely a *protein transition*. Yet without a consolidated set of claims and claim-makers behind them, these pathways are systematically sidelined.

As new policy frameworks emerge, and meat and protein continue to rise up the agenda, it remains critical to move beyond misleading claims. If not, there is a risk that general inaction is replaced with misguided action, that precious opportunities to reinvest in food systems are wasted on pathways that are disruptive but not transformative, and that public good is confused with private good.

The following recommendations are focused on reframing the discussion, overcoming polarization, and putting the conditions and frameworks in place for truly transformative reform pathways to emerge:

RECOMMENDATION 1

SHIFT THE FOCUS FROM A 'PROTEIN TRANSITION' TO SUSTAINABLE FOOD SYSTEM TRANSITIONS AND SUSTAINABLE FOOD POLICIES

Making a 'protein transition' a global imperative and stand-alone policy goal risks penalizing all livestock systems, and promoting 'alternative proteins' irrespective of the risks and uncertainties they entail. However, in some contexts 'animal source food transitions' or 'less and better meat/dairy' can be useful sub-objectives within a comprehensive sustainable food policy, allowing sequenced shifts in production/consumption of animal source foods to be balanced against and informed by other priorities (e.g. GHG emission reductions, territorial cohesion, defending local food cultures) and advanced in relation to overarching objectives (e.g. food and nutrition security, healthy diets, fair and resilient supply chains, sustainable livelihoods). Transformative reform pathways that reconcile these different priorities are more likely to receive the attention they deserve in the remit of a comprehensive food policy. Indeed, any policy with serious ambitions to improve diets will need to look towards comprehensive 'food environment' approaches that connect social policies with food production and supply chain policies, ensuring that as the incentives shift and food prices potentially change, low income populations maintain access to nutritious diets, including animal source foods.

RECOMMENDATION 2

PRIORITIZE REFORM PATHWAYS THAT DELIVER ON ALL ASPECTS OF SUSTAINABILITY, STARTING AT THE TERRITORIAL LEVEL (MEASURE WHAT MATTERS, WHERE IT MATTERS)

A whole range of social and environmental criteria must be taken into account, alongside GHG emissions, in order to comprehensively assess the sustainability of livestock and fishery systems – including impacts on biodiversity, resource efficiency, circularity, resilience, sustainable livelihoods, local nutrient availability and food security, territorial cohesion, and food cultures. Furthermore, it is crucial to consider how animal production systems compare to the most likely alternative land uses and economic activities, in a context where people need access to nutritious foods.

The region/territory is therefore a key level for developing the comprehensive food policies and strategies described in Recommendation 1 – potentially layered into national food policies with multi-level governance approaches. Criteria like resource efficiency and circularity have meaning in their local contexts, and are more likely to be prioritized in regionally-defined food strategies. Focusing on the regional/territorial scale will also help to move beyond abstract assumptions about global land use efficiencies, and to unleash the benefits that many regions can derive from relocalizing livestock production, reintegrating it with landscapes and feed sources, and reusing waste locally/on-farm, while ensuring scale-appropriate trade flows.

..... **RECOMMENDATION 3**

RECLAIM PUBLIC RESOURCES FROM 'BIG PROTEIN', REALIGN INNOVATION PATHWAYS WITH THE PUBLIC GOOD, AND RESET THE DEBATE

Power imbalances create an environment in which misleading claims about meat and protein are rife and a handful of actors can push profitable silver bullet solutions and set the agenda. A number of actions are therefore required to redistribute power and redress the balance. Firstly, a clear set of parameters is needed to assess technologies and realign innovation pathways with the public good. Such criteria are unlikely to be met by channeling public funds into 'alternative proteins': doing so risks giving protein firms greater power to set the terms of debate, and further distorting innovation incentives in favour of so-called 'disruptive' technologies.

Secondly, actions are required to address concentration of power across the food system, including through new approaches to antitrust and competition law. Targeting the practices of a limited number of dominant 'protein' firms could have major ripple effects. Further actions are required to promote organizational diversity and strengthen alternative supply chain infrastructures in a way that rebalances power relations and shifts discussion beyond a narrow choice between industrial meat versus industrial substitutes. Finally, debates on meat and protein must be rebuilt on the understandings and perspectives of diverse actors, including groups whose voices are rarely heard (e.g. pastoralists, artisanal fishers, Indigenous peoples, food insecure groups). This means reinvesting in deliberative democratic processes and consultative decision-making spaces, and resisting attempts to fast-track agreement around seemingly consensual 'solutions'. It also means entering into genuine conversations where ideas are scrutinized, opposing views are confronted, uncertainties are recognized, and normative biases are acknowledged. Only by engaging in inclusive dialogue and overcoming polarization can misleading claims, false solutions, and the vested interests behind them be definitively called out, and transformative change pathways be set in motion.

To conclude, livestock, fish, and 'alternative proteins' will stay in the spotlight for many years to come, as sustainability challenges mount and visions for the future of food systems collide. The solutions put forward and the claims used to advance them will vary between regions and evolve over time. The analysis and the recommendations outlined above are tools that can be used to make sense of claims as they evolve. Underpinning all of these recommendations is the need to broaden our lens and open the door to truly transformative reform pathways.

INTRODUCTION

“ If they can get you asking the wrong questions, they don’t have to worry about answers. ”

THOMAS PYNCHON IN GRAVITY’S RAINBOW (2000)



Animals continue to play a major role in food production systems around the world. The production, processing, and retail of livestock plays a crucial economic role for approximately 60% of rural households in developing countries, and contributes to the livelihoods of about 1.7 billion poor people.¹ The sector also employs as many as 4 million people in the EU, where 58% of farms hold animals, including many small and mid-sized holdings.² Fisheries and aquaculture provide a livelihood for approximately 59.5 million people.³ In addition, marine ecosystems support 37% of the global population,⁴ and more than 3 billion people rely on fish as a primary source of protein.⁵ For a number of populations around the world, however, diets remain primarily based on pulses, grains, and other plant-based foods, with minimal consumption of animal source foods.

Animal production systems have expanded and changed dramatically over recent decades, with major impacts on food systems in all regions. Average meat and fish consumption nearly doubled between 1961 and 2015 – from 22.85kg to 43.17 kg per annum for meat, and from 9kg to 20.5kg for fish.^{6,7} Meat production has risen fourfold over the same period, in a context of rising demand and rapid global population growth.⁸ Increasing demand for animal source foods has largely been driven by the Global North. However, the dynamics have shifted over recent decades: Global South countries accounted for approximately 85%ⁱ of additional global demand for animal source foods from 1998-2018 (See Figure 1).⁹

As well as sustaining the livelihoods of the poorest, livestock now contributes 40-50% of global agricultural GDP.¹⁰ In many parts of the world, **livestock is increasingly concentrated in intensive 'industrial' production units.** By the beginning of the 21st century, some 78% of monogastric production (including eggs) already came from industrial systems, a figure that could reach 85-95% by 2050.¹¹ By 2014, the top 10 meat processing companiesⁱⁱ controlled 75% of beef slaughter, 70% of pork slaughter, and 53% of chicken slaughter.¹² And by 2018, only seven firmsⁱⁱⁱ dominated breeding stock for poultry, pigs, cattle, and aquaculture, and controlled the majority of animal genetics available for producers.^{13,14} Over recent decades, the greatest production increases have come in the poultry and pork sectors, and increasingly in low- and middle-income countries where the rules governing intensive livestock production may be even more lax than in wealthier countries.¹⁵

BOX 1

DEFINING KEY TERMS OF THE 'PROTEIN' DEBATE

In this report we refer to specific sub-sectors and types of animal source and plant-based foods where possible. However, we also use the following terms as shorthand when referring to data/questions pertaining to broader sectors or food categories:

- **'Alternative proteins'**, referring to novel plant-based substitutes, lab-grown meat/fish/dairy products, insect-based protein foods, and other novel manufactured high-protein foods (and excluding tofu, tempeh, seitan and other traditional plant-based preparations). See Box 17 for a full description of 'alternative proteins'.
- **Animal source foods**, referring to meat, dairy, eggs, and fish (and excluding lab-grown versions, which do not involve farming/rearing animals per se).
- **Fish**, referring to all marine animals consumed by humans, including molluscs, crustaceans, and other creatures often described as 'seafood'.
- **Livestock**, referring to all land-based farmed animals raised for meat, dairy, eggs, and non-food products (e.g. fur, leather, wool).
- **Meat**, referring to all land-based animal flesh, including poultry meat.
- **Red meat**, referring primarily to veal, beef, lamb, and pork.



i Data based on consumption volumes (metric tonnes).

ii This includes JBS (Brazil), Tyson (US), Cargill (US), WH Group/Smithfield (China), Brasil Foods (Brazil), NH Foods (Japan), Vion (Netherlands/Germany), Danish Crown (UK), Marfrig (Brazil), and Hormel (US).

iii This includes EW Group, Groupe Grimaud, Tyson, Hendrix/ISA, Genus, Tyson, WH Group, and Charoen Pokphand Group.

FIGURE 1.1

INCREASES IN ANNUAL MEAT CONSUMPTION PER CAPITA (1961-2013)

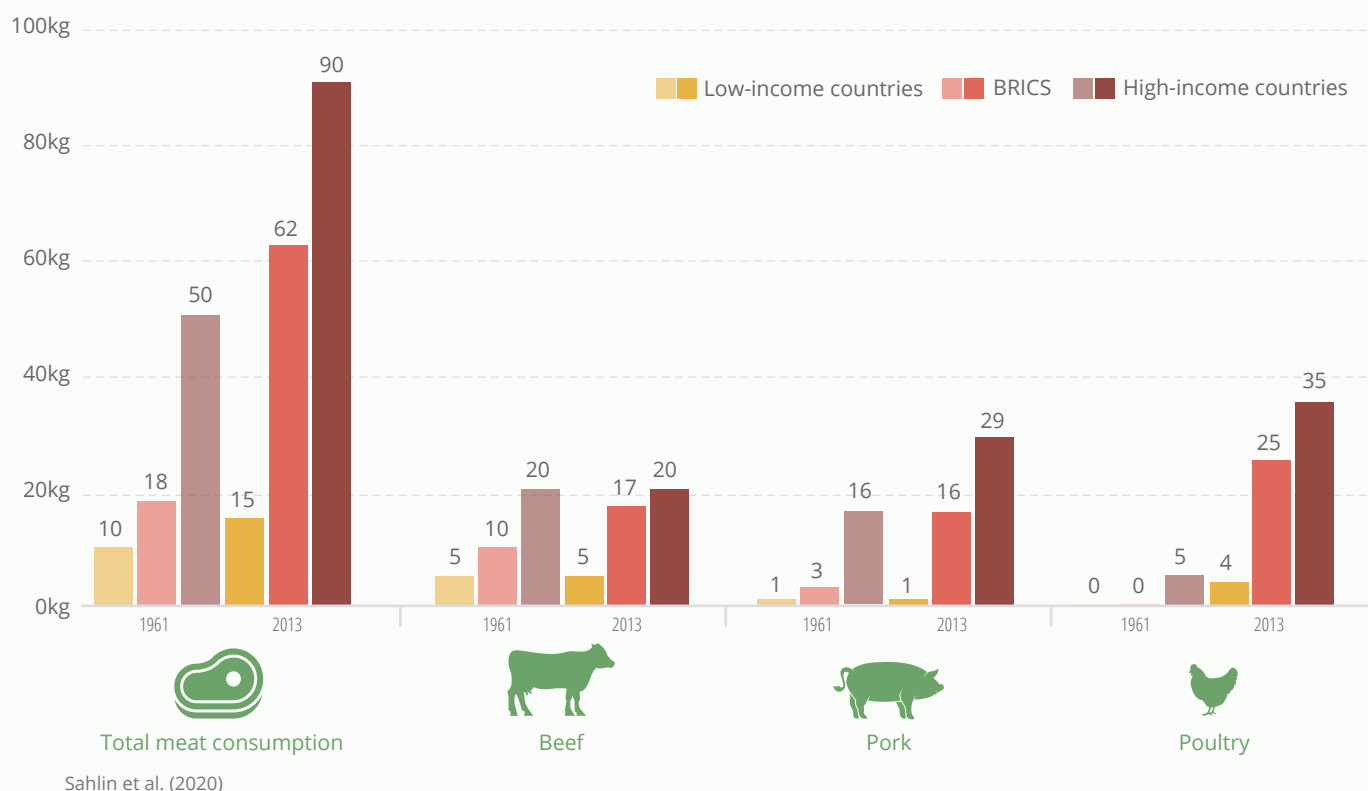


FIGURE 1.2

REGIONAL COMPARISON OF DAILY CONSUMPTION OF ANIMAL VS. PLANT-BASED PROTEIN PER CAPITA (1961 VERSUS 2013)

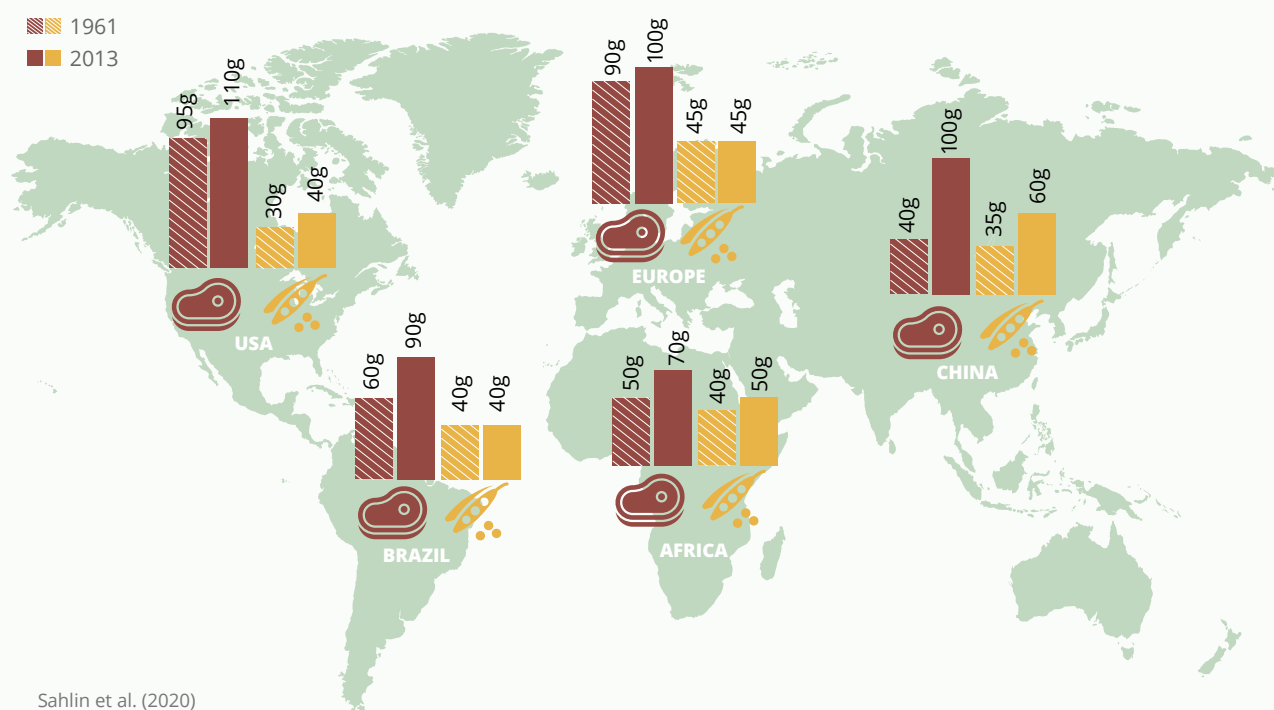
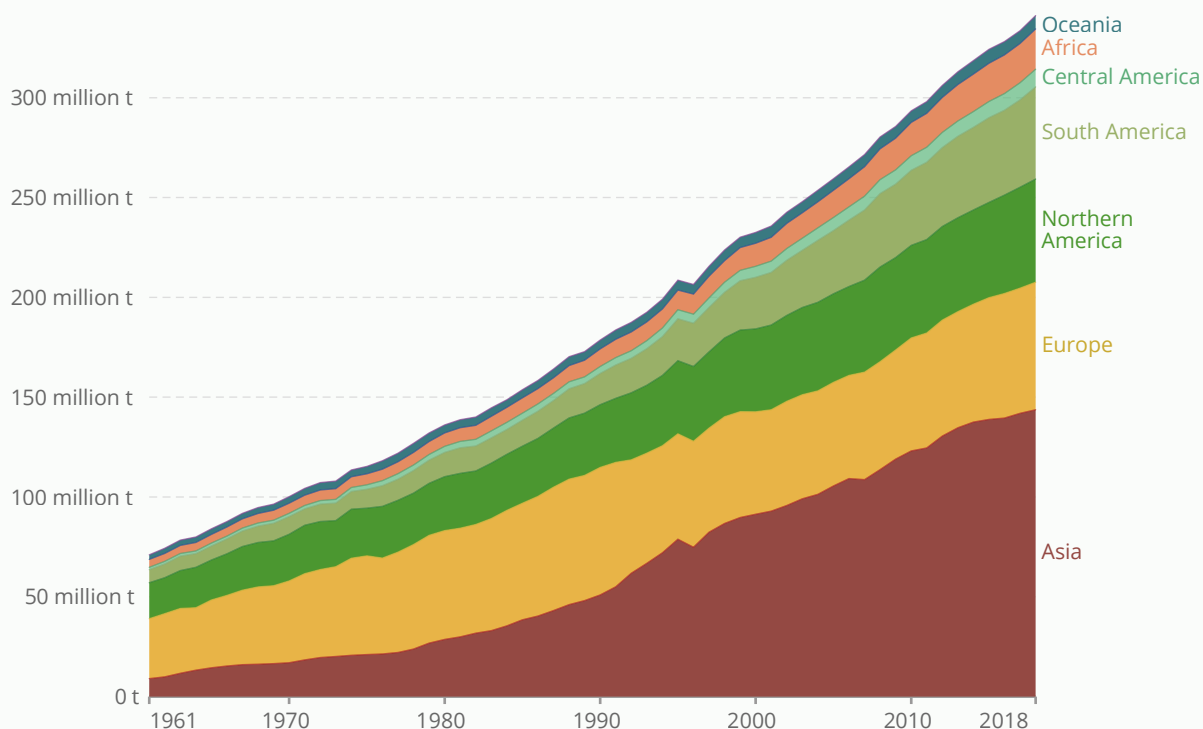


FIGURE 1.3

GLOBAL MEAT PRODUCTION, 1961 TO 2018

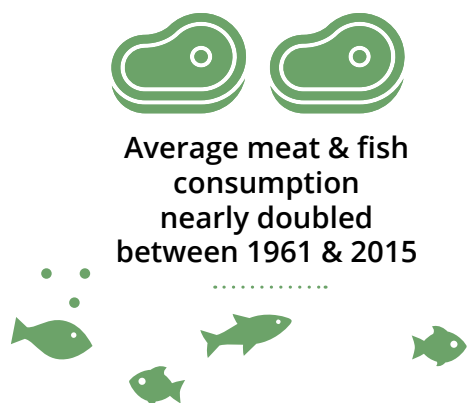


Source: UN Food and Agriculture Organization (FAO)

Industrial meat companies are now expanding into **multiple high-protein food markets** in order to tap new growth opportunities,¹⁶ leading to the emergence of vast firms with huge market share and political clout (see Figure 2).¹⁷ This ‘**protein convergence**’ involves the majority of the world’s leading meat processors, including JBS, Tyson, WH Group, and Cargill. Most of the largest meat processing firms now have poultry, pork, and beef divisions,¹⁸ and the biggest fisheries firms have expanded into salmon aquaculture.¹⁹

With plant-based diets spreading fast (see Box 2), **nearly every large meat and dairy processor/manufacturer has also acquired or developed plant-based meat and dairy substitutes**. These firms are establishing footholds in a market that is growing approximately 20% per year,^{iv} with meat substitutes projected by some analysts to reach annual sales of \$28 billion by 2025²⁰ – although a slowdown in some firms’ US earnings may dampen expectations.²¹

More than a dozen of these firms have made further investments in start-ups^v that are attempting to commercialize **lab-grown meat and fish**.^{22,23} Although conventional animal source foods are forecast to grow only half as fast as substitutes, meat and dairy will still account for as much as 92.3% of the global ‘protein market’ in 2030.²⁴



^{iv} Based on annual growth projections for 2020-2025.

^v Start-ups are new companies founded to develop a unique product or service. They are often supported by venture capital, that is, investors who are interested in innovation and new technologies or services. In the food sector, this can include everything from meal kits to lab-grown meat.

In Baldrige, Rebecca and Benjamin Curry. “What is a Startup?” *Forbes*, February 4, 2022. <https://www.forbes.com/advisor/investing/what-is-a-startup/>

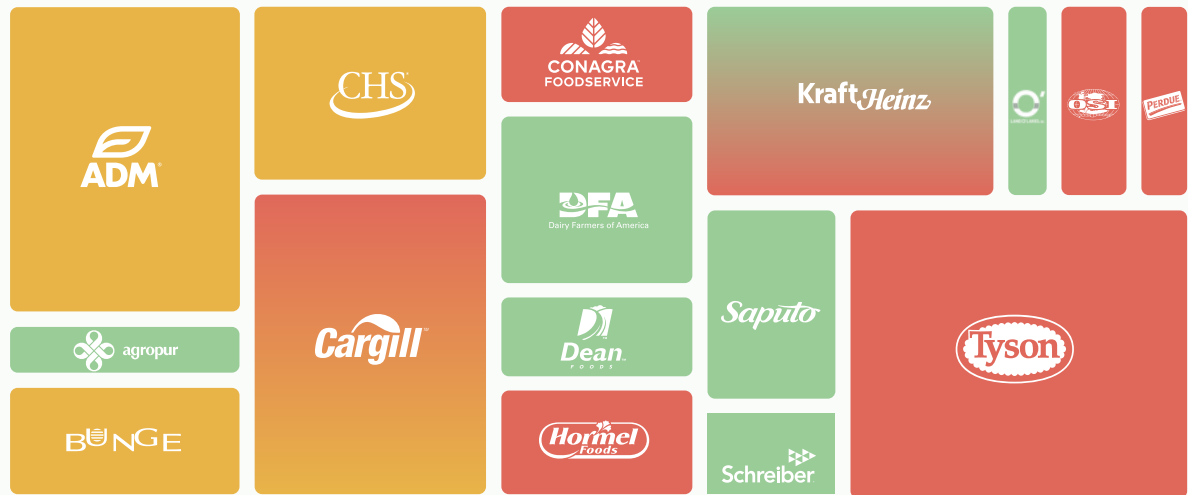
FIGURE 2

MARKET CONCENTRATION IN THE HIGH-PROTEIN FOODS MARKET

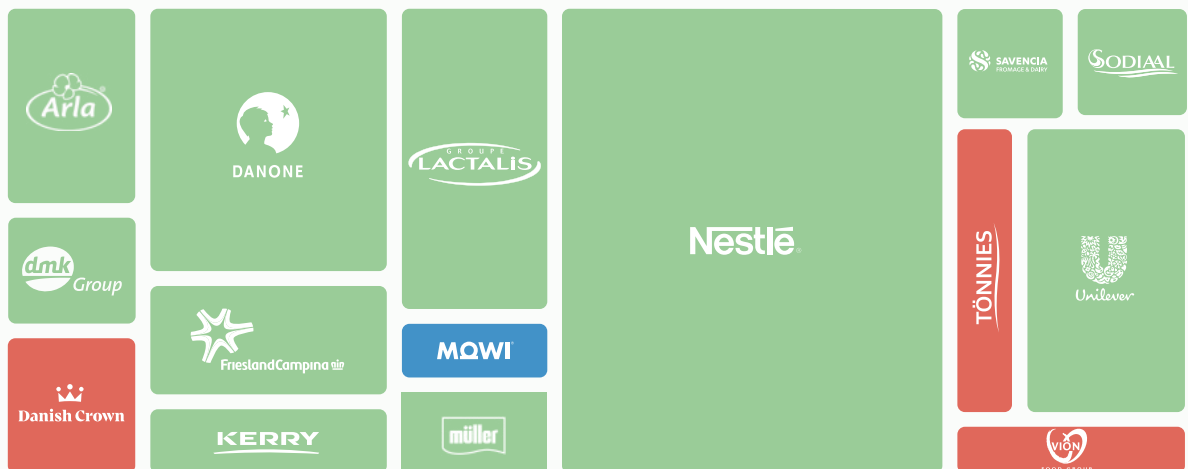
The largest global firms that currently focus on higher protein products, size proportional to food sales in 2019. Dairy and meat processors account for the largest shares.



NORTH AMERICA



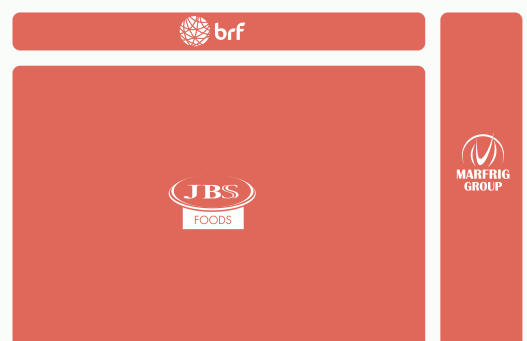
EUROPE



ASIA



SOUTH AMERICA



OCEANIA



BOX 2

VEGETARIANISM AND VEGANISM ON THE RISE

India has long-standing vegetarian traditions, with more than a third of people omitting meat from their diets. However, trends are changing elsewhere, with a rapid increase in vegetarianism and veganism primarily in OECD countries. Between 10% to 14% of the populations of Australia, Israel, New Zealand, Sweden, Switzerland, and Taiwan now follow a vegetarian diet,²⁵ although estimates vary considerably due to varying definitions and the unreliability of self-reporting on diets. Even in Brazil, one of the largest meat producing countries in the world, some 14% of the population identified as vegetarian in 2018.²⁶ In 2018, the number of vegans in the USA was 3% and a further 5% of people identified as vegetarians.²⁷ In the UK, a recently-published 10-year study found that 4.5% of people considered themselves vegetarian or vegan in 2018-2019, up from 1.9% at the outset, while meat-eaters had reduced their consumption by an average of 17%.²⁸ As many as 21% of Americans identify their diets as ‘flexitarian’, referring to a growing trend whereby people reduce their consumption but do not completely avoid animal source foods.²⁹

While the alternative protein boom is currently focused on wealthier countries, **manufacturers clearly have their sights set on Global South markets**. Companies such as Impossible Foods have obtained halal certifications in order to bring their products to the UAE, Malaysia, and other lucrative markets.³⁰ Meanwhile, the Good Food Institute, which works to promote ‘alternative proteins’, has identified India as a target country, despite its currently low levels of meat consumption.³¹

Financial flows are accelerating the ‘protein convergence’. Major **investment funds** and indexes are helping to

rapidly capitalize new plant-based protein and lab-grown meat firms (see Box 3). Common ownership (also known as ‘horizontal shareholding’) is also accelerating in these industries, whereby a handful of **asset managers/private equity firms** buy up shares in multiple companies across the same sector.³² For example, Vanguard and BlackRock have investments in nearly all of the largest firms in the meat, dairy, and animal feed sectors (See Figure 3).³³ The increasing financialization of food systems is clearly shifting power to new actors – including banks, asset managers, and large-scale institutional investors – with implications that are still playing out but are likely to be far-reaching.³⁴

BOX 3

EYE-CATCHING INVESTMENTS IN PROTEIN

- **Breakthrough Energy Ventures**, an investment fund chaired by Bill Gates, has stakes in Impossible Foods and Beyond Meat. Nature’s Fynd, the manufacturer of Fy, an ‘alternative protein’ sourced from fungi and produced through fermentation, raised \$80 million from Breakthrough Energy Ventures and Generation Investment Management in March 2020.³⁵
- The **FAIRR (Farm Animal Investment Risk and Return) Initiative**, a network of investors representing \$45 trillion in assets, has developed an extensive ‘protein producer index’ that focuses on the 60 largest producers of animal source foods (including aquaculture), and scores them based on GHGs, deforestation, water scarcity, waste and pollution, antibiotics, animal welfare, working conditions, and food safety.³⁶ Members include Green Century Capital Management, which filed a shareholder proposal in 2019 requesting that Kraft Heinz “diversify its protein products” by including more plant-based options, although it was voted down.³⁷

These developments are taking place in a context of **unprecedented scrutiny of animal source foods**. With ‘planetary boundaries’ being crossed, the climate crisis accelerating, and threats to food security and human health mounting by the day, *meat* and *protein* have come firmly under the microscope. As production systems have scaled and industrialized in many world regions, their impacts on animals, people, and the planet have grown.

The FAO suggests that livestock account for 14.5% of total greenhouse gas (GHG) emissions,³⁸ with other estimates putting the figure above 30%.³⁹ Furthermore, the IPCC has attributed as much as 33% of anthropogenic methane emissions to livestock.⁴⁰ Intensive animal agriculture is also systematically identified as a leading driver of land degradation, deforestation, and biodiversity loss. More than 60% of human infectious diseases are caused by pathogens shared with wild or domestic animals.⁴¹ Overuse of antibiotics in livestock is a major contributor to infections from antimicrobial resistant pathogens, which are expected to increase 40% by 2050 (from 2014 levels).⁴² Unsafe and abusive working conditions are rife on industrial fishing trawlers and intensive livestock production units, as evidenced by high rates of COVID-19 infection and fatalities in CAFOs and meatpacking plants,⁴³ and forced labour and human trafficking in marine fisheries.⁴⁴ In wealthy and emerging countries, over-consumption of meat and dairy is associated with rising rates of obesity and chronic diseases, while the world’s poorest populations are unable to access adequate food, with up to 811 million people undernourished in 2020.⁴⁵

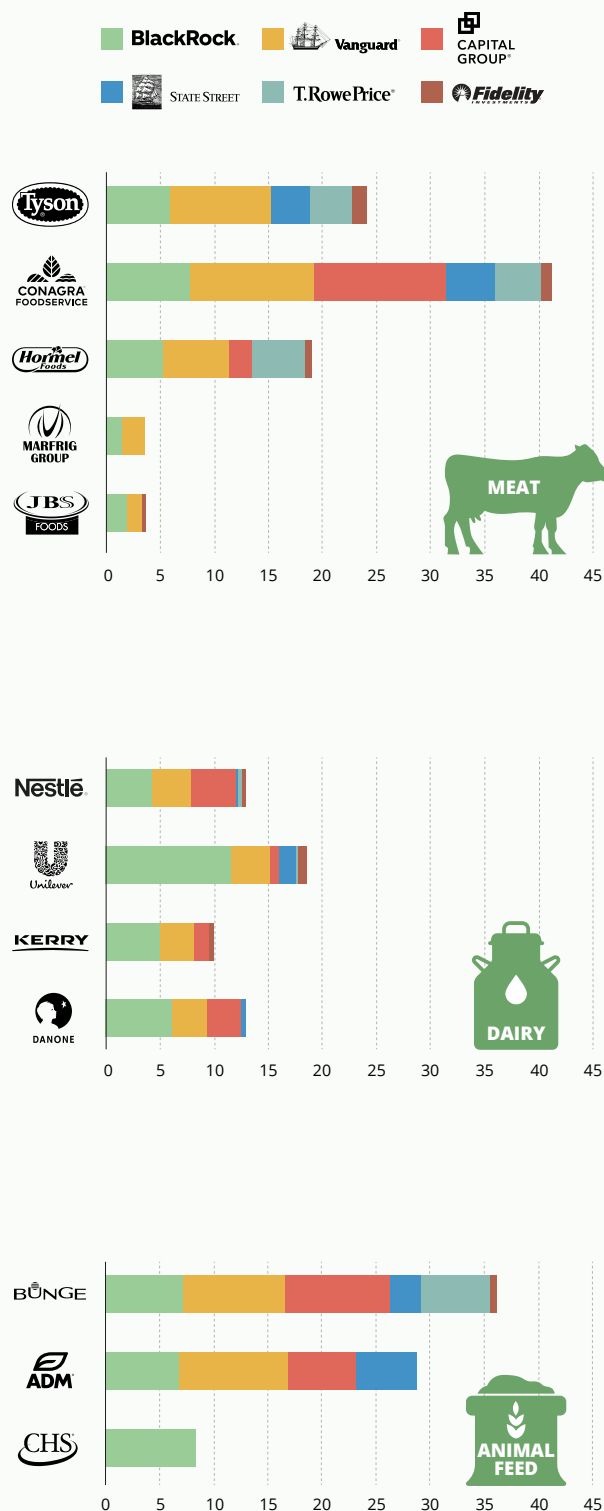
It is clear, therefore, that **the status quo in animal production systems is not an option**, whether we are most concerned with climate change, biodiversity loss, livelihood risks, food security, or animal welfare. Growing awareness of these impacts means that the future of food systems is now rarely discussed without reference to the sustainability of the livestock sector. Similar questions are being asked of fish, whether farmed or wild-caught. And with dietary shifts emerging as a key mode of climate action, public debate is centring on the ‘protein transition’ – a shift away from the consumption of animal proteins and towards plant-based and new protein sources. In the search for answers, the impacts of meat, dairy, eggs, and fish are being compared against one another, against pulses and other high-protein plants, and against ‘alternative proteins’ – including novel plant-based substitutes, lab-grown meat, and insect-based foods.

But the way forward is far from clear. A number of **diverging and conflicting claims** are being advanced about the problems with animal source foods, and how to address those problems.

FIGURE 3

LEADING INSTITUTIONAL INVESTORS IN PROTEIN

Percentages of common stock equivalent held

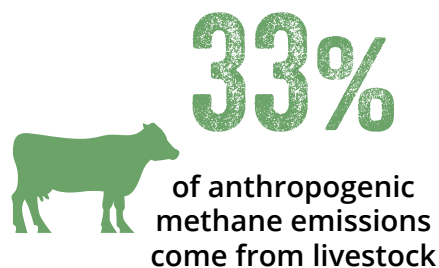


S&P Global Market Intelligence (2021)

The industry reconfiguration described above means that rapid market developments are changing the terrain of the debate as it evolves. In **increasingly high-profile and polarized discussions**, it is not uncommon to find statements such as the following from the CEO of meat substitute firm Impossible Foods, that: “The use of animals in food production is by far the most destructive technology on earth. We see our mission as the last chance to save the planet from environmental catastrophe.”^{46,vi}

In this report, we examine the key claims that are shaping debates on livestock, fish, ‘alternative proteins’, and sustainability (Section 2), and suggest avenues for reframing the discussion (Section 3). Through the analysis, we demonstrate that **claims about high-protein foods are increasingly widespread, highly divergent, and capable of shaping food system debates and decision-making**. A number of claims are widely repeated and accepted as fact, despite being based on uncertain evidence or addressing only certain aspects of the problems in question. We argue that these claims have led to a disproportionate focus on ‘protein’ and ‘protein transition’, a systematic failure to account for the huge differences between different food production models, and a lack of attention to the varying challenges faced in different regions of the world. The resulting debates are characterized by simplifications and over-generalizations.

Typically, animals are reduced to meat, and meat is reduced to protein; GHG mitigation (and particularly CO₂) is often elevated above other sustainability concerns; and the solutions put forward are based on a static view of food systems, rather than seeing them as complex and interconnected systems.



At a critical juncture for food systems reform, the proliferation of competing claims in the ‘protein debate’ is therefore exacerbating tensions and creating further polarization – between animal welfare activists and livestock farmers; environmental and anti-poverty organizations; urban and rural populations; and between meat-eaters, vegetarians, and vegans. We conclude that discussions can and must be reframed. We put forward several recommendations for moving towards a less polarized debate and developing transformative food system reform pathways with broad buy-in.

BOX 4

WHAT ISSUES ARE COVERED IN THIS REPORT?

The focus of this report is on examining specific claims which are setting the terms of debate on livestock, fish, and protein – and are potentially misleading. The report therefore covers a set of issues and questions that are evidentially most contested. In addressing those claims and the arguments they are grounded in, a disproportionate number of the actors and organizations we cite are from Global North-based organizations – reflecting the locus of many of the most powerful voices in these debates. Nonetheless, many of these claims are purportedly universal in scope, and we examine their relevance and validity for various world regions. Furthermore, the focus on examining a specific set of claims means that we only touch on select aspects of big questions like food culture, diets, gender, equity, justice, and rights. Although ‘plant-based diets’ are a crucial reference point throughout the report, we do not describe the various types of plant-based diets around the world, nor do we discuss the relative benefits of various pulses and other high-protein plants in detail here. Furthermore, although different production models diverge considerably in their implications for animal welfare, we consider claims about the general suffering of farmed animals to be patently true, and do not discuss them in detail. Philosophers and ethicists have argued for centuries that hurting animals is amoral. Animals clearly have been demonstrated to be suffering in our modern agricultural systems,⁴⁷ and the latest scientific knowledge points to the importance of ensuring they have positive experiences as part of good animal welfare.⁴⁸ How to act on this evidence is clearly an important ethical question that individuals and societies must grapple with in considering the future of food systems.

vi Comments by Impossible Foods CEO Pat Brown in an interview with The New Yorker.

SECTION 2

ANALYSIS

EIGHT KEY CLAIMS SHAPING
THE DEBATE ON LIVESTOCK,
FISH, AND 'PROTEIN'



In this section, we scrutinize eight key claims about livestock, fish, ‘alternative proteins’, and sustainability. By ‘claims’ we are referring to short statements that identify and frame problems and/or put forward specific solutions and food system trajectories (see Box 5). In identifying which claims to analyse, we conducted an extensive literature review, taking into account the work done by other groups to single out key claims being made in relevant debates in various regional contexts,^{vii} notably around livestock and climate change, and focusing on the claims most often cited by mainstream media outlets, agenda-setting organizations, civil society campaigns, and taken up in policy debates and frameworks. In other words, these are claims that influence perceptions and decision-making in food systems.

While the eight claims we examine are overlapping, each presents a distinct set of arguments and narratives. Claim 1 is particularly foundational, in that it explains the dominant ‘productionist’ bias in our food systems and why we have a ‘protein’ debate in the first place. Claims 2-3 focus on purported problems with meat/livestock. Claim 4 addresses a potential barrier to transformation in the cultural rootedness of animal source food consumption. And Claims 5-8 capture the prevailing ‘solutions’ being advanced in debates around livestock, fish, ‘alternative proteins’, and sustainability. In each case, we identify who is making the claim, in what terms, and on what grounds. We then scrutinize and challenge the claims in question, asking: To what extent are they supported by the evidence, and what types of data do they rely on? How are they framing the argument? Who are these claims addressing? Are they obscuring other ways of understanding and addressing the challenges we face?

BOX 5

WHAT DO WE MEAN BY CLAIMS AND WHY DO THEY MATTER?

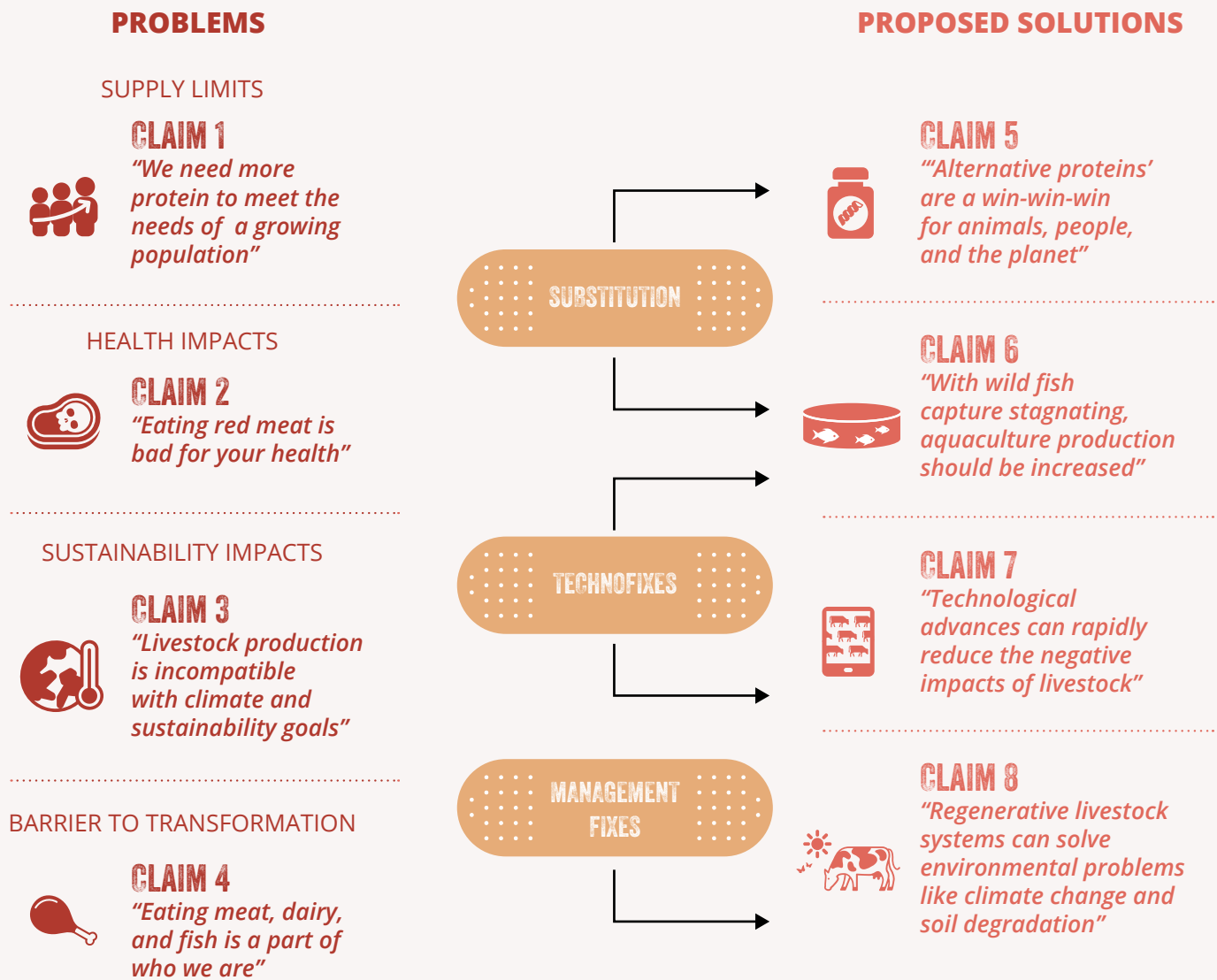
Communication based on claims is characterized by clear, simple messaging, bold or even categorical statements, and the deployment of a restricted amount of information. Claim-making is based on the assumption that providing more nuance or context will exceed the cognitive capacity or ‘bandwidth’ of the target audience (the public, policymakers, etc.). Claims are generally part of a broader set of efforts to influence policy. For the sociologist Joel Best, problems advance through six distinct phases:^{viii} 1) claim-making, 2) media coverage, 3) public reactions, 4) policy making, 5) practical implementation of policies, and 6) policy outcomes.⁴⁹ Arguably, denigrating the claims made by others is another typical step. Claims often rely on establishing frames, stories, discourses, and narratives – and those terms are referenced throughout.⁵⁰ However, we do not examine the story structure of claims made by individuals, nor do we examine in depth what such perspectives have in common as shaped by society and culture. Through this analysis, we link the political economy of claims to their potential biophysical outcomes from a food systems perspective⁵¹ – considering multiple scales, their interactions, trade-offs, and feedback loops, and paying particular attention to claims that are effective for “changing the subject”⁵² and thereby deflecting criticism.⁵³ An example is the claim made by global agribusiness firms and leading policy institutions that the world needs to increase total food production substantially to feed a growing population by mid-century.⁵⁴ This claim conveys a specific ‘productionist’ bias and framing: it implies that global food and nutrition security can be reached simply by increasing food production, while diverting attention from the failure of current food systems to eliminate hunger and micronutrient deficiencies.⁵⁵ Although they may not be universally adopted, claims such as these may reach the status of being above criticism and taken for granted, and “being accused of questioning such assumptions can even become a serious allegation”.⁵⁶

vii A similar project, by De Smog, has compiled claims by a variety of agri-food organizations and corporations around livestock and climate change, finding that most meat firms seek to downplay the emissions from meat production, stress the importance of meat for a healthy diet, and defend the ability of industry-led innovations to solve climate change, while casting doubt on the potential of plant-based alternatives. The project also considers the affiliations, lobbying efforts, and funding of these organizations. See more at: DeSmog. “Meat Industry Climate Claims – Criticisms and Concerns” Accessed March 11, 2022. <https://www.desmog.com/2021/07/18/meat-industry-climate-claims-criticisms-and-concerns/>

viii Best also cautions that, “this linear model oversimplifies the process. Not all... problems pass through all of these stages, or in this order.” Best, 262.

FIGURE 4

EIGHT KEY CLAIMS ABOUT LIVESTOCK, FISH, 'ALTERNATIVE PROTEINS', AND SUSTAINABILITY



CLAIM 1

**“WE NEED MORE PROTEIN
TO MEET THE NEEDS OF
A GROWING POPULATION”**



IN SUMMARY

The claim that there is a gap between protein supply and population needs has long been widespread in global food system debates. With ‘nutritionist’ approaches gaining traction and meat/dairy industries seeking export opportunities, development programs were dominated for decades by protein-enriched therapeutic products and milk marketing. Although some of these approaches had been debunked by the 1970s, debates remain protein-centric. The focus is now on producing enough protein to feed the world in the face of supply constraints and rising demand – although the evidence shows that there is no ‘protein gap’ in terms of global supply versus nutritional needs, and that poverty and poor access to food are the main drivers of various dietary deficiencies. A disproportionate focus on protein is also visible today in media coverage of food systems, the emergence of ‘protein’ companies, the marketing of ever more ‘high-protein’ foods to shoppers, and specialist high-protein diets. While they do so indirectly and sometimes unintentionally, calls for a ‘protein transition’ tend to reinforce a protein-centric approach to food system problems.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Animal source food industries; large-scale farmers’ groups; alternative protein industries; international organizations and research institutions

WHAT IS DEFINED AS THE PROBLEM?

Lack of protein; population growth; under-development

WHAT IS THE PROPOSED SOLUTION?

Increasing production and trade of meat and dairy; nutrition interventions; protein-enriched foods

WHAT ISSUES ARE LEFT OUT?

Poverty reduction; access to nutritious diets; micro-nutrient deficiencies; environmental issues

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

Debates around nutrition have long been dominated by calls to increase protein consumption and close the 'protein gap'. Since nutritionists in the 1930s attributed the widespread incidence of kwashiorkor, a form of acute malnutrition observed in young children, to a lack of protein (see Box 6), discussion of diets and nutrition in Africa – and later, across the Global South – has been focused on addressing protein deficits. As these understandings spread, it became common for governments and other actors to refer to the **global 'protein gap'**, i.e. the purported gap between protein

supply (particularly from meat and dairy) and protein needs (particularly for populations in the Global South). By 1955, the United Nations (UN) had created a special Protein Advisory Group to "fight to close the protein gap".⁵⁷ In 1968, three UN agencies – the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and UNICEF – warned that the 'protein crisis' was a global emergency requiring urgent attention.^{58,59}

With UN agencies increasingly **treating protein malnutrition in isolation from broader nutritional challenges** over this period, billions of dollars were spent on efforts to address the gap, often targeting infants and young children in the Global South.^{60,61,62}

BOX 6

THE MAKINGS OF A 'GREAT PROTEIN FIASCO': EARLY UNDERSTANDINGS OF NUTRITION AND PROTEIN DEFICIENCY

Developed in 19th century Europe, the field of nutrition science established the concepts of macronutrients (protein, fat, and carbohydrate) and calories.⁶³ Early interrogations were focused on quantifying nutrients in foods. Justus von Liebig, one of several scientists who rose to prominence, promoted protein as the "only true nutrient",^{ix} leading to high esteem for meat and its nutritional qualities.^x The 1930s saw an increasing focus on individual nutrients as the key indicator of healthy foods – what might today be described as 'nutritionism'.⁶⁴ From that period onwards, doctors working in the British West African colonies started to identify protein deficiency as the cause of kwashiorkor, a form of acute malnutrition observed in young children.⁶⁵ Pediatricians hypothesized that children were not consuming enough protein due to breastmilk (containing essential amino acids for growth) being replaced too early with high-carbohydrate, low-protein foods such as maize.^{66,67} By the mid-twentieth century, governments were regularly providing guidance on the types of foods needed to prevent nutritional disease, particularly among children and vulnerable populations.⁶⁸ With studies showing the essential role of protein for early childhood development, dietary guidelines favoured high-protein foods – namely meat and dairy – while urging limited fat intake.^{xi} Closing the 'protein gap' was considered the primary global nutritional problem during the 1950s and 1960s, and became the focus of international nutrition research for many years.⁶⁹ Through this period, the WHO and government health agencies around the world used protein:energy ratios (P:E) as the basis for dietary recommendations.^{xii} However, by the early 1970s, nutrition researchers had observed that the diets of those diagnosed with kwashiorkor tended to be lacking in a number of nutrients in addition to protein.⁷⁰ The focus gradually shifted from a 'protein gap' onto a 'food gap', with increasing attention to the causes of malnutrition and poverty.⁷¹ Experts also acknowledged that recommended daily intakes of protein had been overestimated,^{72,73} and using those levels meant that adequately fed children in developing countries – and even in developed countries – would mistakenly be considered as protein deficient.⁷⁴ Since then, protein recommendations for children have been adjusted down by a factor of three. The original proponents of the protein gap theory noted that there were no 'silver bullets' to address global health and nutrition inequities.⁷⁵ The 'protein fiasco' is not the only instance of 'nutritionism' driving the global agenda. The longstanding focus on reducing saturated fat intake also led to unforeseen consequences, and is now considered to have been disproportionate.⁷⁶ Referring to the protein fiasco and the later emphasis on vitamin A, Aya Kimura notes that, "privileging a particular substance as defining the problem (charismatic nutrients) and providing solutions that are highly simplified (nutritional fixes) has been a constant theme in the history of global food interventions."⁷⁷

ix Justus von Liebig, a German organic chemist, was the dominant figure in nutrition science for much of the nineteenth century.

In Kenneth J. Carpenter, "Nutritional Studies in Victorian Prisons," *Journal of Nutrition* 136, no. 1 (2006): 2. 10.1093/jn/136.1.1

x In the mid-1800s, European doctors agreed that meat "exceed[s] all other foods in nutritional power" and access to meat was even considered a fundamental right.

In Knapp, Vincent J. "The Democratization of Meat and Protein in Late Eighteenth- and Nineteenth-Century Europe." *The Historian*, 59, no. 3 (1997): 541–51. <https://www.jstor.org/stable/24451951>

xi Limiting fats – especially saturated fats – was particularly influenced by the work of American physiologist, Ancel Keys, whose 'Seven countries study' observed differences in heart and cardiovascular diseases among countries having shifted from traditional eating patterns and lifestyle. The study also gave way to research on the Mediterranean Diet, and other low-fat diets. In Pett, Katherine, Joel Kahn, Walter Willett, and David Katz. "Ancel Keys and the Seven Countries Study: An Evidence-Based Response to Revisionist Histories." *True Health Initiative*. August 1, 2017. https://www.truehealthinitiative.org/wp-content/uploads/2017/07/SCS-White-Paper.THI_8-1-17.pdf

xii See, for example: FAO & WHO Ad Hoc Expert Committee. "Energy and protein requirements." In *FAO Nutrition Meetings Report Series* (No. 52). Rome, 1973.

Prominent interventions included nutrient-specific supplementation through infant formula and dairy-based therapeutic drinks, the promotion of high-protein cereal strains, the development of single-cell proteins and high-protein powders extracted from fish protein concentrate, as well as increased production of high-protein products from sesame, soy, cotton seeds, and peanuts.^{78,79,80,81}

Some initial understandings had been debunked by the 1970s (see Box 6), and by the 1990s, the WHO, the FAO, and others had adopted the Protein Digestibility-Corrected Amino Acid Score (PDCAAS) to assess the amino acid needs of humans beyond ‘protein’,⁸² before adopting the further-nuanced Digestible Indispensable Amino Acid Score (DIAAS) more recently. Nonetheless, protein-focused approaches and discourses remain common to this day. More recently, the focus has shifted onto a purported **protein production deficit**, in light of rising global demand for animal source foods. The need to produce more food and the need for more protein are often conflated in the productivist narratives that have increasingly been heard in the wake of the 2008 food price crisis. As stated by Noel White, an executive at Tyson Foods, “by 2050 global food systems will need to double protein production to meet the needs of almost 10 billion people”.⁸³ Similarly, an opinion piece in *Wired*, cited by the Good Food Institute, argues that “if we expect to feed a growing population on a planet with finite arable land, we have to engineer new sources of food, protein in particular”.⁸⁴

Furthermore, **major agribusinesses are reorienting and rebranding their operations around protein**, in a way that reinforces the idea that more protein is required globally. As outlined in Section 1, the largest firms are converging across various ‘protein’ sectors and buying up alternative protein start-ups. This is now reflected in their branding and public messaging: Tyson Foods has trademarked the phrase “The Protein Company”;⁸⁵ top executives at Cargill and Hormel have also described their firms as ‘protein’ companies;^{86,87} and Maple Leaf Foods has outlined its vision to be “the most sustainable protein company on earth”.⁸⁸ Firms specializing in meat substitutes have been even more explicit about this convergence:

Beyond Meat has stated that “part of our vision is to re-imagine the meat section as the Protein Section of the store,” as well as trademarking the phrase “The Future of Protein”.⁸⁹

But the focus on protein is not limited to the food industry. With environmental concerns about livestock growing, a number of **civil society organizations** are framing the challenge around a ‘protein transition’, with others calling for ‘less and better meat’, and some referring to these goals interchangeably. New coalitions and pressure groups have formed specifically around protein, including the Netherlands-based Green Protein Alliance^{xiii} and True Animal Protein Price Coalition,^{xiv} as well as the global Forum for the Future’s Protein Challenge 2040 coalition.^{xv}

Protein is also becoming a leading focus of **scientific inquiry** once again. Between 1991 and 2020, for example, academic journal articles containing the search term ‘protein’ coupled with sustainable/sustainability were five times more numerous than articles focusing on fats or carbohydrates plus sustainability, with all three search terms increasing in prevalence over this period (see Figure 5).

“ *The need to produce more food & the need for more protein are often conflated in productivist narratives* ”

Protein has therefore retained or *regained* its central role in discussions on the future of food systems. Although it is used by different actors with different things in mind, **‘protein transition’ has become a regularly cited goal for food system reform**, and a focus for emerging policy frameworks. In parallel, protein per unit of GHG emissions has become one of the default metrics in studies about the sustainability of animal source foods, with calories/GHGs also regularly cited.^{xvi}

xiii The Green Protein Alliance includes 25 members from food retail, the catering industry, and food producers, as well as 10 knowledge partners in the Netherlands. It is supported by the Dutch Government. Its goal is to establish a 50-50 split of plant and animal protein consumption in Dutch diets.

In Green Protein Alliance. (2020). Accessed March 9, 2022. <https://greenproteinalliance.nl/english/>

xiv True Animal Protein Price (TAPP) Coalition represents members from health, farmers and youth organizations, animal welfare and environmental organizations, social ventures and food companies. Its goal is to establish policies that reduce meat and dairy consumption primarily via ‘true cost accounting’ approaches.

In True Animal Protein Price Coalition. “About Us.” Accessed March 9, 2022. <https://www.tappcoalition.eu/about-us-4633779>

xv Forum for the Future is an international sustainability non-profit, and its Protein Challenge 2040 Coalition includes businesses, non-profits, and government organizations, and aims to support “an inclusive protein system that takes into account the livelihoods at stake.”

In Forum for the Future. “Protein Challenge 2040.” Accessed March 9, 2022. <https://www.forumforthefuture.org/protein-challenge>

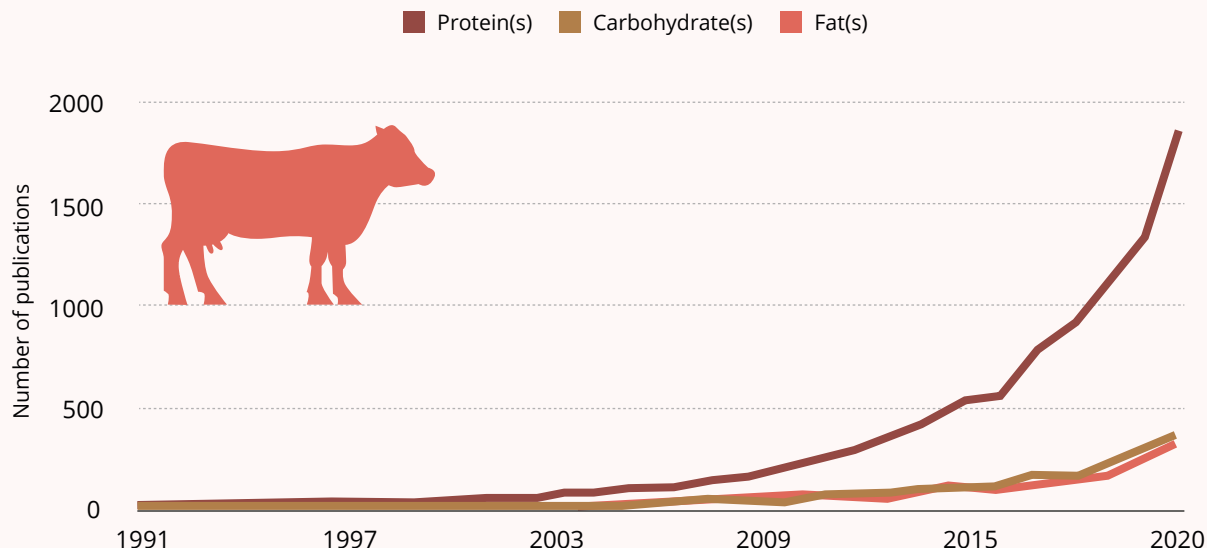
xvi The following is an example of topline coverage in mainstream media following a major new study on the environmental impacts of different diets: “The findings reveal that meat and dairy production is responsible for 60% of agriculture’s greenhouse gas emissions, while the products themselves providing just 18% of calories and 37% of protein levels around the world.”

In Petter, Olivia. “Veganism is ‘single best way’ to reduce our environmental impact, study finds.” *Independent*, September 24, 2020. <https://www.independent.co.uk/life-style/health-and-families/veganism-environmental-impact-planet-reduced-plant-based-diet-humans-study-a8378631.html>

FIGURE 5

WEB OF SCIENCE SEARCHES FOR RESEARCH ON 'PROTEIN AND SUSTAINABILITY'

Below are the results of keyword searches in Web of Science, using the term sustainable/sustainability, combined with a term for a macronutrient: protein(s), fat(s), or carbohydrate(s).



WHY IS THIS CLAIM POTENTIALLY MISLEADING?

Much of the discussion around protein deficits clearly responds to valid concerns about food security, sustainability, and dietary change. However, claims in this area tend to be overstated and potentially misleading.

Firstly, **while protein deficiencies are a reality in specific populations/regions, there is not a global protein deficit.** Data shows that access to dietary protein is generally not a limiting factor for most children in low-income countries, even after accounting for protein quality⁹⁰ – although the metrics typically used to measure protein efficiency may be masking the extent of the problem, according to a recent study.⁹¹ Meanwhile, average protein intake in children in the Global North has been found to be well above recommended levels.^{92,93} Most countries have a total surplus in proteins, and would have greater surpluses were it not for losses in conversion of plant protein to livestock protein via feed crops.

A World Resources Institute study suggests that North and South America are projected to continue producing major surpluses of both plant and animal proteins, and Sub-Saharan Africa is also likely to retain a small surplus.⁹⁴

While the same source suggests that China is facing a growing 'protein deficit' in both plant and animal proteins, recent developments are in fact pointing towards potential pork surpluses in China.^{95,96}

Secondly, **lack of adequate protein intake is only one of many nutritional deficiencies affecting populations around the world** (see Figure 6). A projection to the year 2050 found that in all scenarios, populations in all regions will face calcium and vitamin D deficiencies, while adequate ratios for iron, potassium, zinc, folate, and vitamin E vary according to the regions and scenarios.⁹⁷ Moreover, it is now widely accepted that under-nutrition and micronutrient deficiencies are driven by a complex set of nutritional, socio-political, environmental, and economic factors that include lack of access to adequate diets, improper absorption of nutrients, and lack of safe drinking water and sanitation.^{98,99,100} In this context, protein-centric interventions are unlikely to be the right solution, and discourse focused solely or primarily on 'protein gaps' is likely to be misleading. Although metrics like DIASS are more nuanced than previous measures, some scholars have critiqued these scores for rating specific foods without looking at whole diets and overall protein or amino acid consumption,¹⁰¹ and for excluding the effects of food preparation methods (e.g. fermentation) on the bioavailability of nutrients.¹⁰²

Thirdly, misunderstandings about nutrition have been perpetuated by heavy industry lobbying – leading to a disproportionate focus on protein in public debates and policies. From the start of the ‘protein era’, nutritional concerns were inextricable from the vested interests of agri-food exporters in the Global North. In the 1930s, British colonial veterinary services promoted the intensification of livestock production as the means to increase consumption of dairy products in populations suffering from kwashiorkor.^{103,104} These approaches went hand in hand with ethnocentric development theories that overlooked the effects of colonial rule (e.g. the seizure of fertile land) on dietary changes, emphasizing instead Indigenous knowledge and the lifestyles of African populations as the problem, and biomedical approaches and technological modernization as the solution.^{105,106,107}

\$3M

invested by US livestock industry to influence the 2005 national dietary guidelines

.....

Geopolitical interests amplified these trends: at the height of UNICEF's decades-long milk distribution program, for example, infant formulas for development aid accounted for 15% of US annual dried milk exports.¹⁰⁸ And in 1964, the Harvard Business School published a report entitled *The Protein Paradox: Malnutrition, Protein-rich Foods, and the Role of Business*,¹⁰⁹ which included a framework for how American businesses could produce high-protein food supplements to ‘aid the needy’ and create new markets for long-term growth.^{110,111} Ready to Use Therapeutic Foods (RUTFs) have also been heavily promoted as a response to protein deficiencies in development programmes, although doubts remain about their overall impacts on diets.^{112,113} Today's claims about global or regional ‘protein deficits’ must be seen in this context, and scrutinized with regard to the vested interests of agri-food exporters.

Industry efforts to promote meat and dairy consumption have also led to a **disproportionate and sometimes confusing role for protein in dietary guidelines**.

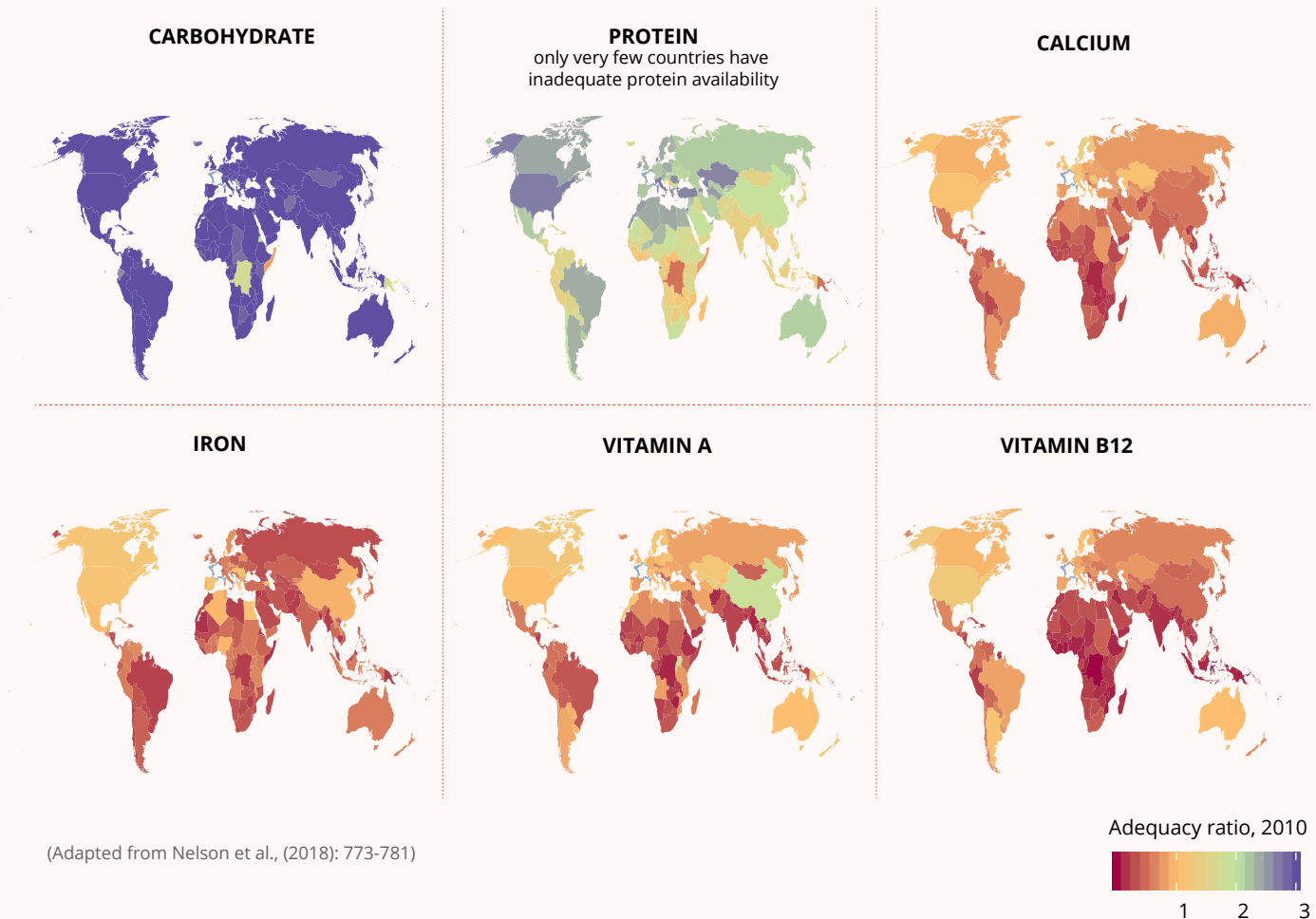
Food pyramids and dietary guidelines developed from the 1950s onwards have often been formulated with a heavy focus on protein, ensuring that meat and milk are essential components of what is understood to be a healthy diet. From 1956 until 1992, for example, the United States Department of Agriculture listed meat and milk as two of the “Basic Four” food groups in its dietary recommendations.¹¹⁴ More than \$3 million was invested by the American livestock industry in the lead-up to the publication of national dietary guidelines in 2005.^{115,116} The resulting guidelines – updated in 2011 – emphasized the primacy of meat as a protein-rich food. Guidelines are less explicitly pro-meat and dairy today, but still call on people to “choose lean meats,” or “choose fat-free or low-fat” or “eat less saturated fat” instead of advising reduced intake of animal source foods – thereby allowing assumptions about the benefits of high protein/high meat and dairy consumption to go unchallenged.^{117,118}

Finally, protein is now at the centre of growing hype around healthy and sustainable diets. Public interest in diets is undoubtedly growing, and is reflected in research, civil society, media, and policy trends. However, people's perceptions are also being shaped by the dominant frames and discourses emerging from studies and media reports, and the legacy of decades of protein-centric discourse and ‘nutritionism’. Industry marketing is clearly playing a role in reinforcing a ‘protein mania’ among shoppers in the Global North, with high-protein product lines proving lucrative for an ever-wider range of items – even bottled waters.¹¹⁹ Specialized high-protein diets are also a growth market, and a source of unfounded claims and misunderstandings about nutrition (see Box 7).

The explosion of media coverage around meat and protein must be viewed in a similar light. A study examining media coverage in the UK and US between 2013 and 2018 found that attention to lab-grown meat was high in 2013 when it was first launched and then declined until 2015-2017 when new investments were announced and debates over labelling began.¹²⁰ The same study found that 75% of articles that were connected to a timely or newsworthy ‘peg’ were prompted by an industry source, and that this coverage was highly favourable to industry perspectives and biased towards the perspectives of manufacturers (see Figure 5).¹²¹ The upsurge of scientific studies on protein and sustainability also reflects the weight of industry funding and priority-setting, with the private sector having a long track record of shaping research trajectories in food and nutrition.¹²²

FIGURE 6**A COMPLEX PICTURE: NUTRIENT DEFICIENCIES AROUND THE WORLD**

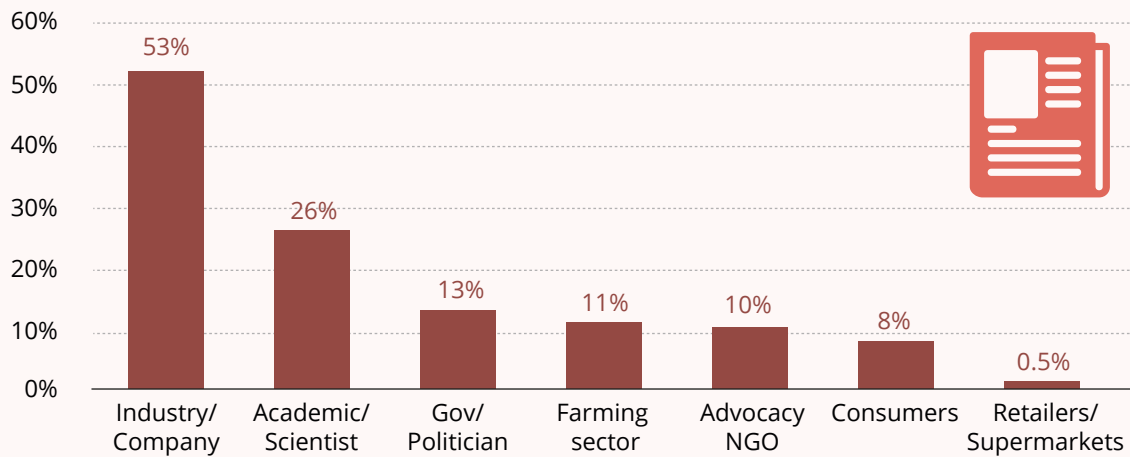
In this figure, ‘adequacy ratio’ refers to the ratio of average nutrient availability from a number of modelled commodities to the requirement of a representative consumer as defined by age- and gender-specific requirements. A value of 1 means that average availability is equal to the representative consumer requirement.

**BOX 7****HIGH-PROTEIN DIETS**

Ketogenic, Atkins, and “paleo” diets that restrict the consumption of carbohydrates and emphasize protein consumption have recently spread. In 2021, estimated global sales of sports nutrition products (such as protein powders, drinks and bars) totaled approximately \$47.5 billion, with rapid growth in Asia, North America, and Europe.¹²³ According to a 2017 report released by market research firm Mintel, 27% of the UK population uses protein supplementation products such as protein bars and shakes,¹²⁴ with more than half unsure whether they are having the desired effect on their health. And while it is rare, excess protein consumption can cause kidney and liver problems for some people. However, high-protein, low-carbohydrate diets have gained traction in wellness and fitness communities online, and are being recommended for everything from losing weight, to improving hair and skin, reducing inflammation, and managing mental health conditions such as ADHD. A growing number of researchers are now pointing to the century-long obsession with protein and ‘nutritionism’ as a leading cause of fad dieting and ‘nutritional anxiety’ in the Global North.

FIGURE 7**MEDIA COVERAGE OF LAB-GROWN MEAT**

Distribution of actors quoted directly or indirectly in an article on the topic of lab-grown meat. Data covers 255 articles on lab-grown meat in leading US and UK newspapers between 2013-2019.



Source: Painter et al. 2020, p. 2388

WHAT CAN WE CONCLUDE?

Misleading claims about protein have been able to gain traction in a context where the frames of the debate have been clearly established (with protein in the spotlight) and internalized into public policy and discourse. Debate in this area carries the legacy of long-standing scientific misconceptions, marketing campaigns, vested interests, and path-dependent policy approaches. Assumptions about a 'protein gap' of some type continue to underpin many of

the claims made in debates around the future of food systems. Protein deficiencies are real, but generic claims about the need for more protein tend to extrapolate beyond these contexts, and often ignore other important considerations. Agri-food industries have clearly helped to frame discussion around protein – through lobbying and more subtle influences on public debate. Even when done indirectly or unintentionally, calls for a 'protein transition' tend to reinforce the (disproportionate) focus on protein as a problem in food systems, and various high-protein foods as a solution.

CLAIM 2

**“EATING RED MEAT IS
BAD FOR YOUR HEALTH”**



IN SUMMARY

Claims about health impacts are based on a large body of evidence linking chronic disease risks to red and processed meat consumption. These claims have often come alongside dietary recommendations to curb or eliminate red meat consumption, and/or the promotion of vegan and vegetarian diets. However, the prevailing claims overstate and over-generalize the health risks of red meat, which are partly determined by how livestock are raised and finished, and how meat is prepared and consumed. Meanwhile, the fact that (red) meat is an important source of micronutrients and high-quality bioavailable protein for many populations around the world is regularly overlooked. Furthermore, a holistic view of how meat/livestock interacts with human health is often missing: although they do not affect people as directly as nutritional impacts, a number of severe human health risks result from the environmental contamination caused by industrial livestock.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Some medical associations and health campaigners; vegetarian groups; alternative protein industries

WHAT IS DEFINED AS THE PROBLEM?

Red meat causes chronic diseases

WHAT IS THE PROPOSED SOLUTION?

Reducing or eliminating red meat consumption

WHAT ISSUES ARE LEFT OUT?

Access to nutrition for food insecure populations; impacts of different production systems and preparation methods; livestock-driven environmental health risks

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

Claims about the negative health impacts of red meat are long-standing, and are among the most common critiques of the status quo with regard to animal source foods. Claims in this area generally focus on the **chronic disease risks** incurred by eating red meat or processed red meat. While the discussion is generally framed in terms of *suspected* health risks, bolder claims – e.g., red meat as a “killer” or the cause of “killer diseases”^{xvii} – are not uncommon in mainstream media coverage. The focus of claims tends to shift fluidly between red meat and meat more broadly; concerns about red meat are often articulated alongside broader claims about the health impacts of high meat consumption. For example, plant-based substitutes have been promoted as a healthier option to meat on various fronts – e.g. nutritional profile, avoidance of risks linked to antibiotics, hormones, banned drugs, and heavy metals used in animal production – in comparative statements which generally refer to burgers, minced beef, and other red meats.¹²⁵

Claims about the health risks of red meat are often found in the remit of **dietary recommendations and other policy imperatives** for limiting meat consumption. For example, in 2019, the EAT-Lancet Commission recommended a ‘planetary health diet’ with zero or very low (14 grams per day) consumption of red and processed meat, and low to moderate amounts of seafood and poultry, with the authors claiming that it could prevent over 11 million diet-related premature deaths every year.^{126,127} The European Commission effectively echoed the claim that red meat is bad for people’s health in advocating reduced intake of red and processed meat as part of its recently-launched cancer plan – although the Commission stepped back from previous wording calling for a complete phasing out of red meat promotion,^{128,129} and continues to subsidize the meat and dairy sectors through the Common Agricultural Policy (CAP).

Claims in this area are underpinned by a large body of evidence showing clear associations between red and processed meat, and chronic disease risks – including long-term cohort studies and meta-analyses. Several studies have linked diets rich in red meat with cancer, type-2 diabetes,¹³⁰ and heart disease.^{131,132} A study led by the Harvard School of Public Health suggested that increases in red meat consumption, especially processed meat, were associated with higher overall mortality rates.^{133,134}

“ *Grass-fed livestock provide a healthier ratio of omega-6 to omega-3 fatty acids & higher levels of antioxidants compared to grain-fed meat* ”

On the basis of such evidence, the International Agency for Research on Cancer (IARC) identified processed red meat as a group 1 carcinogen – an agent known to cause cancer in humans.¹³⁵

In parallel, meat-free diets have been associated with a range of improved health outcomes, including lowering overall mortality and ischemic heart disease mortality,¹³⁶ reducing the need for medication,^{137,138} supporting sustainable weight management,^{139,140} reducing incidence and severity of high-risk conditions such as obesity¹⁴¹ and obesity-related inflammatory markers,¹⁴² hyperglycemia,^{143,144} hypertension,^{145,146} and hyperlipidemia,¹⁴⁷ and even reversing advanced cardiovascular disease (CVD) and type 2 diabetes.^{148,149}

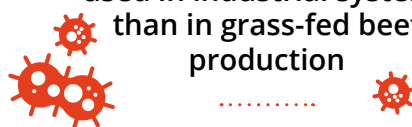
xvii See, for example: Ingham, John. “Eating meat regularly ‘causes killer diseases’.” *Express*, March 3, 2021. <https://www.express.co.uk/life-style/health/1404838/Meat-eating-side-effects-killer-disease-latest-study-researchers>

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

Firstly, diet-health links are notoriously difficult to prove. Evidence is largely based on observational studies, given the ethical and practical barriers to dietary clinical trials. Observational studies can only show correlation, not cause and effect, due to the large number of compounding factors. For example, those who consume high levels of red and processed meat tend to score highly on other unhealthy lifestyle factors.^{xviii} Results may also be skewed by generally health-conscious people opting to reduce their (red) meat intake in response to health authorities having promoted this behaviour.¹⁵⁰ The chances of misreporting (intentional or unintentional) and “recall bias” are also high in observational diet studies.¹⁵¹ Results can vary dramatically depending on how studies are designed and what parameters are set. For example, while much of the evidence confirms the links between red meat and chronic disease risks, a long-term study involving nearly 30,000 people found that all types of meat – processed meat, unprocessed red meat, poultry – were significantly associated with incident CVD.¹⁵² These factors do not change the fact that the evidence clearly points towards heightened health risks for regular consumers of red and processed meat. They do, however, make it difficult – and potentially misleading – to make categorical statements or claims about those risks.

x3

more antimicrobials are
used in industrial systems
than in grass-fed beef
production



Secondly, there are significant differences in the nutritional value and health risks of meat depending on how livestock are raised. Meat from grass-fed livestock has been found to provide a better average ratio of Omega-3 to Omega-6 fatty acids and higher levels of antioxidants, including vitamins A and E, compared to grain-fed meat.¹⁵³

Emerging data also indicate that when pasture-fed livestock are eating a diverse array of plants, additional health-promoting phytonutrients^{xix} become concentrated in their meat and milk – benefits that are lost in “phytochemically impoverished pastures” and feedlot diets.^{154,155} Higher phytonutrient concentrations have been shown to lower cholesterol levels, low-grade systemic inflammation, cardiovascular disease risk, and cancer risk.¹⁵⁶ Nonetheless, research in this area remains scarce: studies linking high-meat diets and chronic diseases very seldom differentiate between consumption of grass-fed and industrially-reared meat, and further research may be required before drawing definitive conclusions.

Furthermore, claims about the effects of (red) meat on human health tend to address only direct impacts, and in doing so they overlook a whole range of health risks linked to the environmental contamination driven by industrial livestock production (see Claim 3). One of these risks – antimicrobial resistance (AMR) – is worth noting here given its direct and indirect transmission pathways, and the fact that it is one of the world’s fastest-growing health crises. Although some sectors/countries have made progress over recent years in reducing their usage in feedlots, roughly three times more antimicrobials are used in industrial systems than in grass-fed beef production^{157,158} – with total usage across the livestock sector predicted to rise by at least 67% over the 2010-2030 period.¹⁵⁹

Thirdly, how meat is processed and prepared also has a significant impact on the health risks of consuming it. Although a large number of cohort studies have linked unprocessed red meat with the same chronic disease risks as processed red meat, others have not.^{160,161} For example, a large international prospective study recently found that the links between unprocessed red meat intake and CVD risks were far less clear than for processed meat.¹⁶²

Although the molecular reactions in meat are highly complex, the way that meat is prepared also appears to have a significant impact on health risks. Grilling, barbecuing, and other high temperature cooking methods affect the formation of several known carcinogens in meat, including heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs); the additives and preservatives in processed meat, including N-nitroso compounds, are also associated with cancer risks.^{163,164}

xviii “Our analysis has several limitations. Because of the observational nature of the study, we cannot automatically assume the causality of the observed relations. In particular, residual confounding cannot be completely excluded, although we controlled detailed assessments of demographic and lifestyle factors in the current analyses.” In Zheng et al. “Association of changes in red meat consumption.”

xix Phytonutrients are beneficial phytochemical compounds that are ingested and act as anti-inflammatory, anti-carcinogenic, and/or cardioprotective. They include terpenoids, phenols, carotenoids, and antioxidants.

In Szalay, Jessie. “What are Phytonutrients?” *LiveScience*, October 21, 2015. <https://www.livescience.com/52541-phytonutrients.html>

Finally, claims about health impacts tend to focus almost exclusively on chronic disease risks, while ignoring the contribution of red meat to another critical component of health: food and nutrition security. Due to their rich nutrient profiles (see Box 8), the addition of animal source foods to monotonous (non-diverse) plant-based diets translates into improved health outcomes, such as growth¹⁶⁵ and cognitive function¹⁶⁶ in newborns and children¹⁶⁷ – who may need to derive adequate nutrition from smaller quantities of food. Studies in South Asia have shown that animal source foods such as liver, small whole fish, mollusks, ruminant meat, and eggs, among others, are key foods for a number of undernourished populations, especially young children, adolescents, and women of reproductive age.¹⁶⁸

BOX 8

THE NUTRITIONAL BENEFITS OF ANIMAL SOURCE FOODS

Based on the Digestible Indispensable Amino Acid Score (DIAAS),^{xx} animal source foods contain a more complete set of amino acids than most plant-based foods. In most cases, they include all nine of the indispensable amino acids (those which cannot be produced by the body) and have a higher amino acid digestibility. In addition to offering high-quality proteins, animal source foods also contain essential micronutrients such as zinc, vitamin B12, calcium and iron – nutrients which are less readily available in plant-based foods.¹⁷⁵ For example, red meats contain haem iron, the most bioavailable form of iron, with an absorption of between 15% and 40%, whereas plant-based foods contain non-haem iron with an absorption of only 1-15%.¹⁷⁶ Nonetheless, these differences can potentially be offset by highly diverse plant-based diets: some studies focused on specific population groups in high-income settings have reported adequate nutrition whether diets include meat or not;^{177,178,179} for example, studies show no significant difference in iron deficiency between those consuming red meat and people with plant-based diets that include multiple sources of vitamin C – which aids iron absorption¹⁸⁰ – and iron.¹⁸¹

WHAT CAN WE CONCLUDE?

Overall, it is clear that high consumption of red meat is one of a number of behaviours which are likely to increase chronic disease risks. However, it is also clear that the risks depend on how that meat has been raised, processed, and prepared, with low/moderate consumption of unprocessed red meat (cooked at moderate temperature) likely compatible with a healthy diet.¹⁸² The prevailing claims overstate and over-generalize the health impacts of red meat, while emphasizing specific impacts of concern to specific populations.

While some generic claims about red meat may deliberately ignore these nuances, in other cases, they are a result of loss of context and nuance as scientific findings

For the 1.5 billion people in the world who are mainly vegetarian ‘by necessity’,¹⁶⁹ with diets based on staple grains and starchy vegetables, small amounts of animal source foods could improve intake of complete proteins and deliver nutritional benefits.¹⁷⁰ In some cases, diets rich in meat might even be *more* adequate. For example, genetic and physiologic adaptations to their climate mean that Inuit populations require a diet rich in omega-3 polyunsaturated fatty acids.¹⁷¹ However, it is crucial to note that a sufficiently diverse plant-based diet may also provide adequate nutrition without exposing people to the chronic disease risks associated with high intake of red and processed meat (see Box 8).^{172,173,174}

are translated to a broader public. Even when studies have identified health risks in a range of animal source foods, the main messages communicated and taken up by the media have focused on red meat.^{183,184}

A vicious cycle perpetuates the prominent framings: the interest in proving or disproving the risks of red meat drives a disproportionate focus on studies designed to that effect, and a corresponding lack of research into the impacts of different production systems. These problems also reflect the fact that claims about (red) meat are often being made through a Global North lens – based on assumptions that do not hold for the world’s poorest countries. These questions are further discussed in Section 3.

xx The protein quality score of a food source is calculated based on analysis of the amino acid profile and digestibility. The Digestible Indispensable Amino Acid Score (DIAAS) is the comprehensive system to score the quality of protein in foods. DIAAS determines amino acid digestibility, at the end of the small intestine, providing a measure of the amounts of amino acids absorbed by the body and the protein’s contribution to human amino acid and nitrogen requirements. In other terms, DIAAS scores reflect the true digestibility of the indispensable amino acids that are present in food items.

In FAO. *Dietary protein quality evaluation in human nutrition*. Rome: FAO Food and Nutrition Paper, 92, 2013, 1-66. <https://www.fao.org/documents/card/en/c/ab5c9fca-dd15-58e0-93a8-d71e028c8282/>

CLAIM 3

**“LIVESTOCK PRODUCTION
IS INCOMPATIBLE
WITH CLIMATE AND
SUSTAINABILITY GOALS”**



IN SUMMARY

A wealth of studies have singled out livestock production as a major global driver of climate change, land degradation, and biodiversity loss, leading many actors to question its compatibility with the transition to sustainability. However, claims in this area often rely on simplistic approaches that fail to capture the complexity of livestock-ecosystem interactions or to account for the huge differences between industrial and agroecological livestock systems, and between world regions. Focusing only on narrow metrics like protein/GHGs ignores other crucial and interconnected aspects of sustainability (e.g. biodiversity, resource efficiency, livelihoods). It also overlooks the multifunctional role livestock plays in many farming communities, and the many contexts where it may compare favourably to alternative land uses and economic activities. Life Cycle Assessments (LCAs) allow impacts to be captured more holistically, but the boundaries and methodologies remain contested. Generalized claims about livestock's sustainability impacts are therefore highly misleading, and end up conflating systems that are barely comparable.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Alternative protein industries; vegetarian/vegan groups; moderated versions of the claim espoused by many environmental groups and other civil society organizations and scientific bodies

WHAT IS DEFINED AS THE PROBLEM?

Livestock causes environmental problems such as climate change, land degradation, biodiversity loss, water, and soil pollution

WHAT IS THE PROPOSED SOLUTION?

Livestock production/ consumption should be drastically reduced and replaced by plant-based diets (including 'alternative proteins')

WHAT ISSUES ARE LEFT OUT?

Differences between livestock systems; multifunctionality of extensive and pastoralist systems; livelihoods

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

The 2006 FAO report, *Livestock's Long Shadow*, was one of the first major publications to identify livestock as a key driver of climate change. The report also found that livestock is a major contributor to land degradation, air pollution, water pollution, over-extraction, and loss of biodiversity.¹⁸⁵ Since then, studies on the environmental impacts of livestock have proliferated, and claims about the unsustainability of animal production systems have become widespread – sometimes referring to livestock in general, and in other cases pinpointing industrial systems. Many commentators, organizations, and individuals have determined that eating meat is unethical because of the environmental harms it causes.¹⁸⁶ The environmental campaign organization Greenpeace has identified the global industrial meat industry as the driver of wide-ranging issues from “climate change to forest fires to human rights abuses”.¹⁸⁷ Conservation societies, like WWF, have also underlined the importance of reducing the production of meat and animal source foods to spare land and protect biodiversity.¹⁸⁸

Claims about the unsustainability of livestock often equate the sector with other high-impact extractive industries, for example by referring to ‘peak meat’,^{xxi} and comparing grass-to-meat with coal-to-energy conversion.^{xxii} According to the Good Food Institute, which works to promote ‘alternative proteins’, “industrial animal agriculture may be the most environmentally damaging industry on Earth”.¹⁸⁹ While the discussion below is focused on livestock, it is worth noting that similar claims about the fundamental unsustainability of eating fish are now being made, notably by the chart-topping 2021 Netflix documentary *Seaspiracy*.¹⁹⁰

These claims are underpinned by compelling data on the environmental footprint of livestock, and particularly GHG emissions. The FAO suggests that livestock account for 14.5% of total GHG emissions.¹⁹¹ However, other estimates put the figure considerably higher, reflecting wide-ranging methodologies and parameters (see Box 9). Livestock production is also clearly linked to **biodiversity loss**: converting forests and savannas for animal agriculture and feed crops crowds out native ecosystems and biodiversity,¹⁹² as well as increasing risks of zoonotic disease outbreaks.¹⁹³ In parallel, the ammonia emitted by manure leads to unintended fertilization of forests and other ecosystems, contributing significantly to terrestrial

biodiversity loss.¹⁹⁴ Feed cropping also contributes to aquatic biodiversity loss via fertilizer runoff.^{195,196} Furthermore, the seminal *Long Shadow* report found that approximately 70% of **deforestation** in the Amazon was due to pasture conversion, and most of the remaining clearance was for soy and other feed crops.¹⁹⁷ It also identified livestock as a major driver of **land degradation**, affecting about 20% of pasture and 73% of rangelands in dryland areas.



70%

of deforestation in the Amazon
is due to pasture conversion

In light of these impacts, **livestock production has increasingly been cast as an inefficient use of land and resources**, particularly in comparison with plant-based foods and other potential land uses. Although estimates vary, some data indicate that livestock uses nearly 80% of all agricultural land (see Figure 8), with as much as 30% of total arable land used for feed crop production.¹⁹⁸ Although the data needs to be unpacked (see below), one study puts the water footprint as high as 15,415 litres per kg of beef and 4,235 litres per kg of chicken, compared to 962 litres per kg of fruits and only 322 litres per kg of vegetables (see Figure 9).¹⁹⁹

Studies have highlighted that in spite of these impacts, livestock provides only 37% of our protein and 18% of our calories,²⁰⁰ with animals typically consuming more food macronutrients than they produce.²⁰¹ These inefficiencies have sometimes been quantified in terms of ‘**carbon opportunity cost**’, given the potential of alternative land uses to sequester carbon through ecosystem restoration or ‘rewilding’ (see Claim 5). One study suggests that the cumulative potential of carbon removal through conversion of native grassland areas/reforestation/afforestation on land currently used for livestock farming is equivalent to the past decade of global GHG emissions.²⁰²

xxi ‘Peak meat’ refers to the point where conventional meat consumption begins to fall, and suggests an analogy with ‘peak oil’.

In Carrington, Damian. “Europe and the US could reach ‘peak meat’ in 2025 – report.” *The Guardian*. March 23, 2021. <https://www.theguardian.com/environment/2021/mar/23/europe-and-us-could-reach-peak-meat-in-2025-report>

xxii Lead author of a University of Oxford study, Joseph Poore, said that “converting grass into [meat] is like converting coal to energy. It comes with an immense cost in emissions.” In Petter, Olivia. “Veganism is ‘Single Biggest Way’ to Reduce our Environmental Impact, Study Finds.” *Independent* September 24, 2020. <https://www.independent.co.uk/life-style/health-and-families/veganism-environmental-impact-planet-reduced-plant-based-diet-humans-study-a8378631.html>

In the wake of COVID-19, the threats of livestock systems to **food system resilience** have increasingly been emphasized alongside broader sustainability claims. In particular, meat production has been linked to increased epidemic risks, either directly through increased contact

between wild and farmed animals or indirectly through the impacts of land clearance for grazing and feed crop production (e.g. biodiversity and habitat loss, climate change).

BOX 9

WHAT SHARE OF GHGS COME FROM LIVESTOCK?

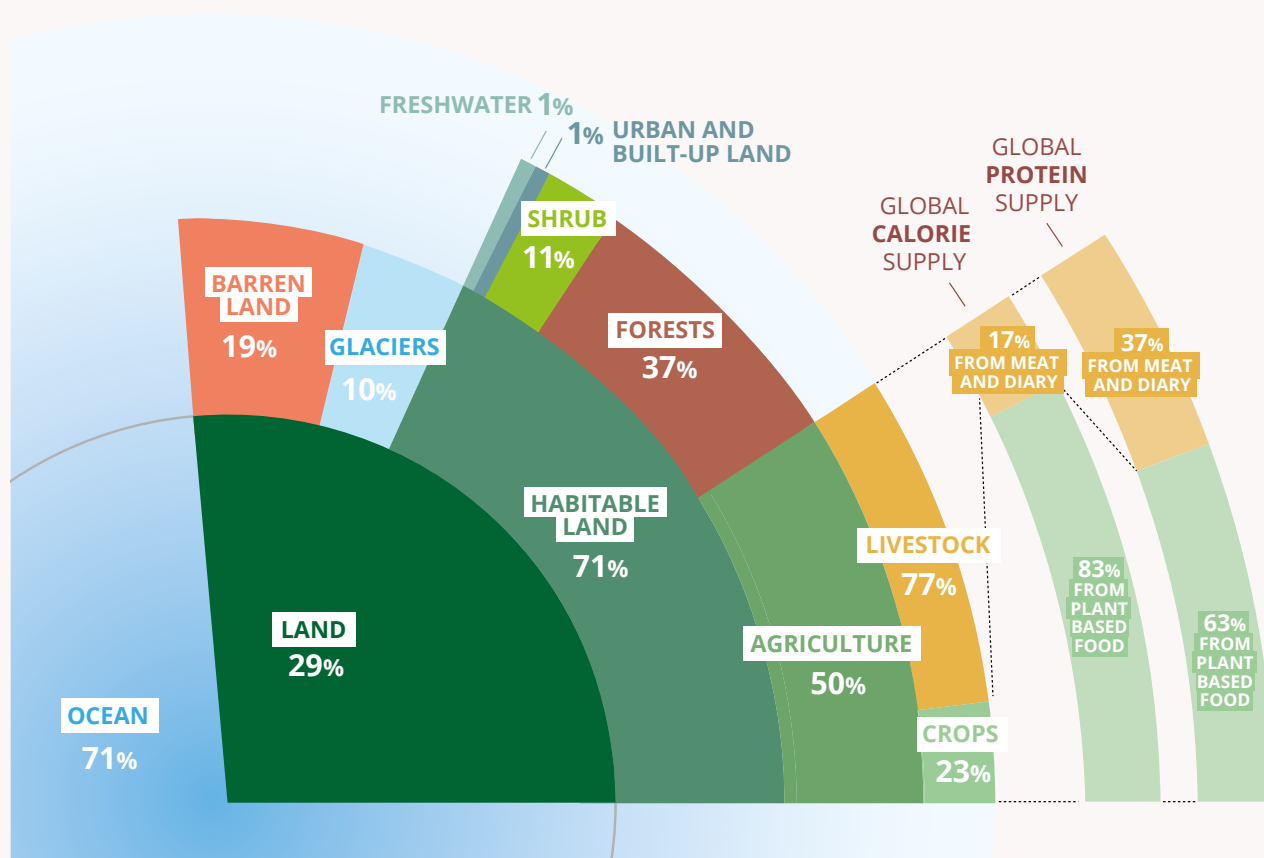
Livestock contribute to emissions in several ways: cattle and other ruminant livestock produce high levels of methane (CH₄) through their digestive processes (enteric fermentation). Land use for livestock – including land use change, savannah burning and cultivation of feed – accounts for 16% of food system emissions.^{xxiii} Meanwhile, some 5% of total GHG emissions (in this case CH₄ and NO₂) are estimated to derive from manure.^{203,204} Consumption of electricity, gas and fuels in the meat processing industries are also important GHG contributors.²⁰⁵ According to the FAO, 14.5% of global GHGs can be attributed to livestock.²⁰⁶ But some studies put livestock's share of GHGs as low as 6%, while a recent paper from scientists at the University of Illinois attributed more than 30% of GHGs to livestock.²⁰⁷ Recent studies also revised up livestock's share of agricultural emissions to 56%-58%.²⁰⁸ Estimates vary considerably depending on the methodology and assumptions, in particular whether the figure covers only direct emissions from livestock, or total emissions along the chain and over the product's life cycle.^{209,210} Even when taking the latter approach, uncertainties abound (see below re 'LCAs').

xxiii This figure is the sum of 12% land use change + 2% savannah burning + 2% cultivated soils.

In Poore, Joseph and Thomas Nemecek. "Reducing food's environmental impacts through producers and consumers." *Science* 360, no. 6392 (2018): 987-992. 10.1126/science.aag0216

FIGURE 8

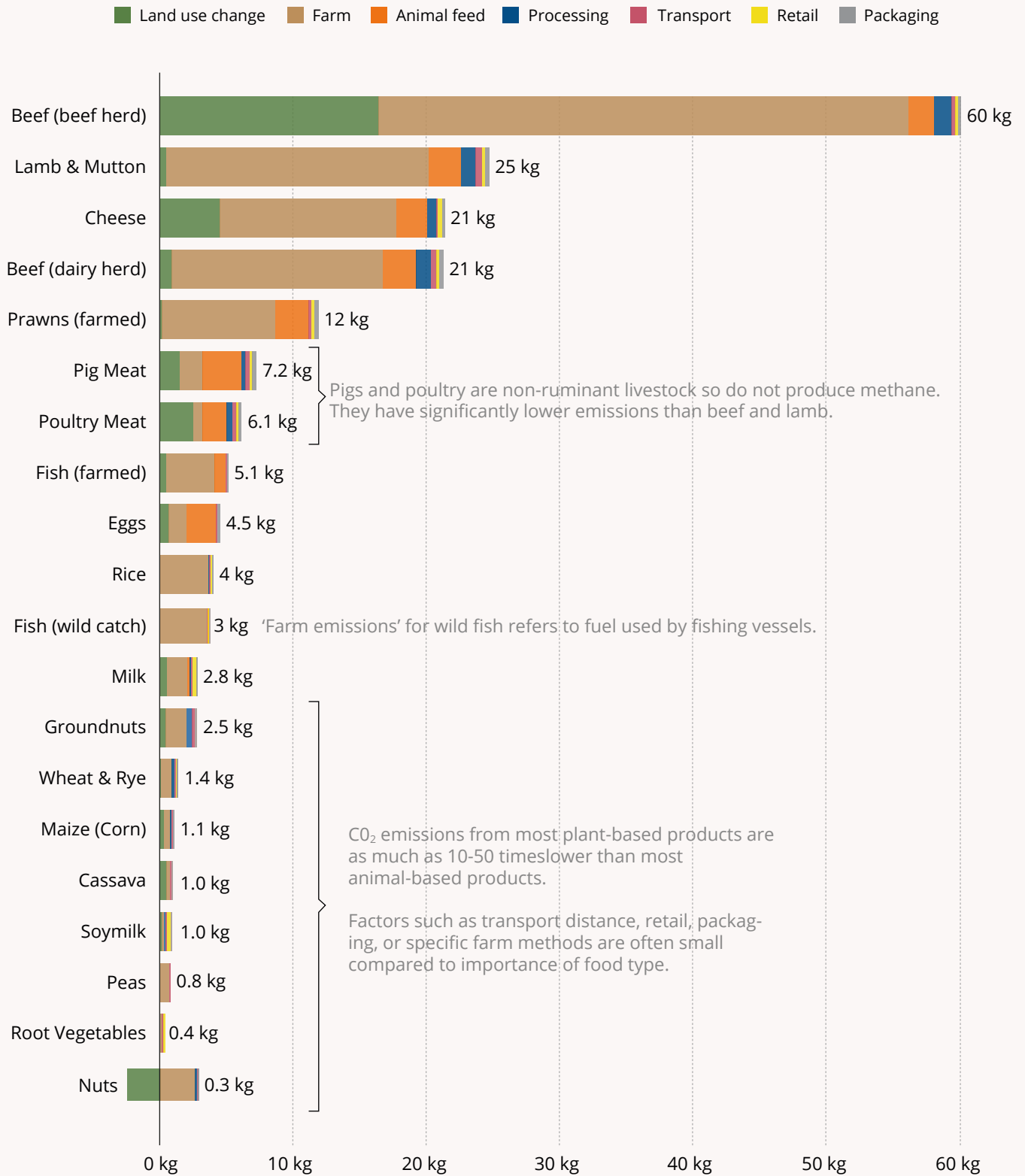
GLOBAL LAND USE FOR FOOD PRODUCTION



(adapted from <https://ourworldindata.org/agricultural-land-by-global-diets>)

FIGURE 9

COMPARING GHG EMISSIONS BETWEEN FOOD PRODUCTS

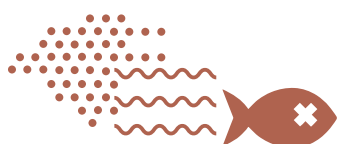


(source: <https://ourworldindata.org/food-ghg-emissions>)

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

While the evidence is compelling, claims about the unsustainability of livestock are sometimes overstated and potentially misleading as a result of failure to distinguish between different livestock sectors and systems, and limitations in how we understand their impacts and interactions with ecosystems.

Firstly, claims often fail to differentiate between *industrial* livestock and other production systems. Livestock systems remain highly diverse – between sectors and between world regions (see Box 10). The differences along the spectrum of livestock production cannot be overstated, particularly when the full range of interconnected impacts on the environment and human health are considered.



**Industrial livestock farming
is responsible for widespread
contamination of air, soil & water**

In particular, the feed crops required by industrial feedlots come at a huge environmental cost (see Box 11). Furthermore, industrial livestock farming is responsible for widespread contamination of air, soil, and water, with major impacts on human health.^{211,212}

For example, poor air quality due to emissions of dust particles, gases, and endotoxins are associated with respiratory infections, asthma, and chronic bronchitis of industrial livestock farm workers and those who live in close proximity to farms.^{213,214,215} Other risks accumulate along the industrial livestock chain. Pathogenic diseases such as Campylobacteriosis, Nipah virus, Q fever, hepatitis E, and a variety of novel influenza variants can be traced back to slaughterhouses and other industrial animal production facilities.²¹⁶ Furthermore, high density, genetic proximity, increased immunodeficiency, and live transport of farmed animals all help to facilitate the spread of diseases in industrial livestock systems.^{217,218,219} These threats to the resilience of food systems were demonstrated by the high incidence of COVID-19 outbreaks in meat processing plants,²²⁰ and the resulting shutdowns leading to product shortages and farmers having to euthanize livestock.²²¹

Extensive livestock systems^{xxiv} are by no means exempt from negative impacts. From the perspective of GHG reductions and ‘carbon opportunity costs’, extensive systems have been identified by some studies as a bigger problem than industrial livestock.²²² Nonetheless, when viewed holistically, these systems and their respective risks/benefits are clearly different in nature. Statements conflating them can therefore be highly misleading. Crucially, there is a similar failure to disaggregate the ‘plant-based diets’ against which livestock systems are regularly compared (see Box 12).

BOX 10

THE DIVERSITY OF GLOBAL LIVESTOCK SYSTEMS

The world’s livestock systems remain highly diverse, reflecting different resource endowments, demand patterns, market structures, agro-climatic conditions, and government support.^{223,224} The FAO estimates that in 2000, 78% of monogastric production (including eggs) came from industrial systems, and by 2050, it may reach 85-95%. The report also noted that in China 90% of poultry and 74% of pigs were raised in intensive systems, even higher rates than in high-income countries.²²⁵ By contrast, ruminant production (including dairy) was found to be stabilizing closer to 10% ‘industrial’ – mostly situated in the US, Brazil, and Australia. In many world regions, especially Africa, small-scale and pastoralist systems are still the dominant livestock production model, despite Global North-based firms and agencies promoting the expansion of industrial feedlots into those regions. Another FAO study found that approximately 85% of rural households in sub-Saharan Africa keep poultry for household consumption and to support livelihoods, with women owning 70% of the hens.²²⁶

xxiv Extensive livestock systems are characterized by low stocking rates and are located on permanent grasslands or pastures.

In Horsin, Anne, Claire Lebras, and Jean-Pierre Theau. “Extensive Livestock Production.” DICO AE: Dictionary of Agroecology. Accessed March 14, 2022. <https://dicoagroecologie.fr/en/encyclopedia/extensive-livestock-production/>

BOX 11**THE ENVIRONMENTAL IMPACTS OF FEED CROPS**

Some 98% of livestock's estimated water footprint is accounted for by animal feed cultivation.²²⁷ A comparative study also found that industrial-conventional livestock fed on grains require 53.1–90.1% more water than regenerative-multi-paddock systems.²²⁸ Likewise, much of the water pollution associated with livestock relates to pesticide use in feed crop production (particularly soy),²²⁹ although livestock manure and fertilizer runoff are also significant causes of eutrophication.²³⁰ Soil erosion and the possibility of sedimentation is more common in feed crops such as corn and soy because they are typically produced using intensive tillage.²³¹ Approximately one fifth of the soy exported to the EU from Brazil's Amazon and Cerrado regions is linked to illegal deforestation.²³² Soy exports to China are also one of the main drivers of deforestation in Brazil.²³³ When land is converted to feed crop production, even if it was previously used as grazing land, there is a major loss of wildlife habitat and biodiversity.²³⁴

Secondly, there is a systematic failure to measure what matters when considering the sustainability of livestock systems. As described in Claim 1, livestock systems are increasingly being measured in terms of protein or calories produced per unit of GHGs, e.g. CO₂ equivalent per 100g of protein. Focusing solely or primarily on this metric is reductive, given that livestock systems interact with and impact on the environment in multiple, interconnected ways – and are a major driver of another planetary crisis in biodiversity loss.

These metrics are also reductive in terms of the other side of the equation: what livestock systems can yield. As shown in discussion of Claims 1-2, animal source foods can be a crucial source of quality protein, as well as delivering a wide range of micronutrients. One study suggests that meat in fact incurs fewer GHG emissions than some vegetables in delivering the Recommended Daily Allowance (RDA) of Essential Amino Acids (EAAs) – a key indicator of food quality.²³⁵ Furthermore, feed conversion ratios and other efficiency indicators emphasize edible outputs only and ignore the multifunctionality of livestock. In many farming communities, animals play multiple roles: they provide food, hides, wool, and traction, help fertilize soils, act as financial collateral, hold cultural value, and make use of marginal land in a way that brings livelihoods, income, and food security to regions with few alternatives. A protein/GHG-focused lens therefore means a narrow vision of sustainability. It compounds the failure to recognize and differentiate livestock systems, leading to vast and unhelpful generalizations, and ultimately draws attention away from the multiple, interconnected problems with industrial livestock.

BOX 12**GENERALIZATIONS ABOUT 'PLANT-BASED DIETS'**

Claims about 'plant-based diets' or 'vegetarian/vegan diets', often made in conjunction with claims about meat/livestock, are also subject to generalizations. A prominent study in 2022 announced that in high-income countries, 2/3 of agricultural emissions could be cut by shifting to a mostly plant-based diet,²³⁶ but the study assumed adoption of a universal diet across all high-income countries and did not differentiate according to production methods. Although another major comparative study in 2018 took different production systems into account,²³⁷ its findings were presented in simple terms, with the authors identifying a plant-based diet as the "single biggest way to reduce your impact on planet Earth" and highlighting the huge benefits if "the most harmful half of meat and dairy production was replaced by plant-based food".^{xxv} Through statements like these, plant-based diets are framed as a singular, standardized entity that can be universally adopted in place of meat-based diets, with unequivocally positive impacts for the environment and human health. These simplifications are problematic considering the wealth of different plant foods and ways of producing them, and the emergence of highly-processed meat substitutes (see discussion of Claim 5), which are now regularly included under the umbrella of plant-based diets.

xxv "The large variability in environmental impact from different farms does present an opportunity for reducing the harm, Poore said, without needing the global population to become vegan. If the most harmful half of meat and dairy production was replaced by plant-based food, this still delivers about two-thirds of the benefits of getting rid of all meat and dairy production."

In Carrington, Damian. "Avoiding meat and dairy is 'single biggest way' to reduce your impact on Earth." *The Guardian*. May 31, 2018. <https://www.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth>; original study: <https://www.science.org/doi/10.1126/science.aag0216>

Thirdly, metrics for capturing impacts across animals' life cycles are still unreliable. Life Cycle Assessment (LCA) is now used in a number of sectors to quantify the 'cradle-to-grave' impacts of production processes – including extraction of materials, manufacturing, distribution, use, and eventual disposal – in terms of pollution, GHG emissions, and land and water usage.²³⁸ LCA approaches have the potential to improve at least partly on the narrow metrics described above. However, the complexities of livestock systems make LCAs more challenging to interpret than in other sectors. Firstly, inclusion of some emission sources in LCAs has been contested, such as animal respiration, emissions related to feed production (fertilizer and pesticides, forest clearance, peatland drainage), and post-farm transport.²³⁹ Meanwhile, LCAs do not systematically include non-food items like leather in the equation,²⁴⁰ and in the dairy sector, question marks remain about how to account for impacts relating to male calves destined for meat production.²⁴¹ Further, the methods for measuring GHG emissions and the climate effects of different gases are contested (see Box 13). Emissions typically cannot be measured, but rather are modelled, often using generic data. This means a failure to capture the variation in emissions depending on climate, weather patterns, soil, topography, as well as on-farm practices, and thus a loss of accuracy.²⁴²

Water footprints are another seemingly broad metric that can be misleading. The often-cited figure of 15,000 litres of water needed for 1kg of beef is in fact based on aggregating 'blue water' (surface and groundwater) and 'green water' (water lost from soils by evaporation and transpiration from plants derived directly from rainfall).²⁴³ Blue water requirements per kg of beef are in fact in the region of 550-700 litres.²⁴⁴

WHAT CAN WE CONCLUDE?

It is clear that there is **huge variation in how livestock interact with ecosystems in different production systems**. Generic, definitive, and simplistic claims about livestock's sustainability impacts therefore conflate systems that are barely comparable. Clearly, single indicators are insufficient and often misleading.

The regional (North/South) divide means that the translation of generic claims into generalized policy imperatives is doubly problematic. This discussion raises questions about the fundamental comparability of different livestock systems/high-protein foods, about how we measure sustainability, and to whom specific claims apply. These questions will be further explored in Section 3.

BOX 13

CONTESTED APPROACHES TO CALCULATING GHG EMISSIONS

The standard reporting of GHG emissions (GWP100 CO₂ footprint)^{xxvi} may result in a significant loss of information, and have implications for the apparent emissions efficiency of, for example, different types of ruminant systems, or the relative climate impact of beef production compared to other GHG-emitting activities.²⁴⁵ This is particularly important regarding how to weigh emissions from methane (CH₄) and nitrous oxide (N₂O), the main greenhouse gases emitted by livestock.²⁴⁶ Both of these GHGs have a much stronger warming potential than CO₂, but a shorter lifetime in the atmosphere. As a consequence, surface temperatures respond differently to carbon dioxide and methane emissions: while CO₂ accumulates in the atmosphere and hence every new tonne of CO₂ causes additional warming, methane is broken down by natural processes on a timescale of about 12 years. Consequently, surface temperatures are much more responsive to changes in methane emissions: very slowly declining methane emissions (-0.3%/year) keep warming constant; faster cuts cause cooling; while any increase causes substantial additional warming.²⁴⁷ The ratio between CH₄ and N₂O is therefore important: attempts to reduce methane by shifting from ruminants to monogastrics can offset the benefits by increasing N₂O emissions.

xxvi The Global Warming Potential (GWP) of a greenhouse gas is its ability to trap extra heat in the atmosphere over time relative to carbon dioxide (CO₂). This is most often calculated over 100 years, and is known as the 100 year GWP.

CLAIM 4

**“EATING MEAT, DAIRY,
AND FISH IS A PART OF
WHO WE ARE”**



IN SUMMARY

The cultural rootedness of animal source foods is often cited as a major barrier to dietary shifts. It is also one of the arguments in favour of 'alternative proteins', with highly meat-like novel products seen by some as the only viable way to reduce the consumption of meat and other animal source foods. It is clear that raising and eating animals has played a significant role in shaping human development. Eating meat is now a part of many culinary traditions and food cultures around the world. However, cultural norms around animal source foods remain highly diverse, reflecting a plurality of relationships to animals. These norms are also in constant evolution. Habits have been reshaped by corporate strategies and government imperatives: current trends towards high consumption of animal source foods are a function of rapid food system industrialization, the promotion of Western-style diets, and the (re)structuring of food access. Despite the efforts of marketers to play on cultural attachments to meat, current trends do not (yet) constitute long-term cultural norms, and further significant shifts in the role of meat and the role of animals in our societies are possible.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Meat and dairy industries; alternative protein industries; farmers' organizations; consumer groups

WHAT IS DEFINED AS THE PROBLEM?

Eating meat is central to cultures and identities, and cannot/should not simply be phased out

WHAT IS THE PROPOSED SOLUTION?

Continue eating animal source foods or adopt highly meat-like substitutes

WHAT ISSUES ARE LEFT OUT?

Diverse cultural norms re. animal source foods; the fluidity of food cultures; the role of marketing/lobbying in shaping diet preferences

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

For many people, the cultural rootedness of meat-eating is the starting point for all discussion in this area. In many regions of the world, meat consumption is inextricable from cultural traditions. For Brazilians, barbecuing meat has been described as a “long established tradition of community cohesion which punctuates the week”.²⁴⁸ *Churrasco* – barbecues with large servings of red meat – is also seen as a key component of gaúcho culture in southern Brazil, Argentina, and Uruguay.²⁴⁹ In promoting meat substitutes, the Good Food Institute states that “America’s food culture centres on meat – from family recipes and holiday dinners to haute cuisine and dollar menus,” arguing that shifting to meat substitutes will deliver quicker returns “than if we tried to change food culture”²⁵⁰ (see also Claim 5). In North America, the centrality of meat in Indigenous diets has also been stressed, alongside warnings that questioning meat is to question those cultural identities.^{xxvii} Some go further, arguing that eating meat is what has made us human in an evolutionary sense,²⁵¹ while proponents of ‘carnivorism’ from the wellness community often draw parallels to the meat-heavy diets of *Homo erectus*.^{252 253}

In examining these claims and the surrounding evidence, two assertions appear to be clear and well-evidenced, although they may appear to contradict one another:

1) that meat is embedded in our societies and cultures on multiple levels, and 2) that food cultures are highly fluid and subject to a number of influences.

A large body of evidence shows that raising and eating animals has played a significant role in shaping human physical development and socio-cultural relations for millennia. In many societies, people continue to interact with animals daily to ensure that they are fed, watered, milked, bred, slaughtered, processed, and stored. For hunters, pastoralists, fishing communities, and many other populations, fish and livestock are not only a primary source of livelihood but also play an important role in the organization of political and social structures.²⁵⁴ For example, animals may be used to establish prestige, as a dowry, as currency, as draught animals, for transportation, and to sustain spiritual relationships through sacrifices.²⁵⁵

Animal source foods are also tied to long-standing cultural identities through their central role in moments of celebration and festivity.²⁵⁶ Culinary traditions that emphasize meat and celebration include goat or sheep meat at Eid al-Adha, turkey at Thanksgiving, ham or poultry at Christmas, beef brisket at Hanukkah, and fish, chicken, duck, or pork for Lunar New Year. Nonetheless, religious-spiritual beliefs are highly diverse in regard to meat consumption, and in some cases, they enshrine the avoidance of meat-eating, or occasional consumption with symbolic value (see Box 14).

BOX 14

SPIRITUAL AND RELIGIOUS TRADITIONS AROUND EATING ANIMALS

For many Indigenous people across North America, hunting wild animals is considered an inherent part of spirituality – with Indigenous epistemologies providing a contrast to the narratives of power, hierarchy, and domination characteristic of the human-animal relationship in Western societies. For example, in many communities, offerings of tobacco are made to thank animals for giving themselves to hunters.²⁵⁷ From this perspective, eating meat becomes a spiritual act rather than a consumptive one.²⁵⁸ The Māori, for example, uphold a different and more interconnected conceptualization of humans’ relationship to animals and the environment,²⁵⁹ underpinning hunting and fishing practices that avoid overharvesting.²⁶⁰ Prohibition of certain types of meat at certain times has in fact been observed in various societies over centuries, often linked to spiritual and religious beliefs. For example, abstention from meat is linked to Jainism and East Asian Buddhist traditions. While a correlation between meat consumption and social class could also be found in Ancient China²⁶¹ and Japan,²⁶² the prevalence of Buddhism and Shintoism respectively led to social attitudes that viewed meat-eating as unethical and unclean. Encouragement of vegetarianism on the Indian subcontinent arose during the Vedic period (c. 1500-c.500 BCE), with prohibition of beef consumption marking the development of Hinduism.²⁶³ Vegetarianism or partial vegetarianism, through fasting or the dietary omission of certain types of animals, is also prevalent in select Judaic, Christian, and Muslim traditions.^{264,265} These traditions cite a diversity of reasons for restricting/avoiding meat, including animal welfare, environmental ethics, moral character, or food safety and health.

xxvii These concerns have been strong enough to spark changes to the nutritional guidelines of countries like Canada and the US to include more ‘country foods’ including wild game. In Brake, Justin. “First Nations, Inuit and Métis food guides may be coming, Health Canada indicates.” *APTN National News*. January 25, 2019. <https://www.aptnnews.ca/national-news/first-nations-inuit-an-metis-food-guides-may-be-coming-health-canada-indicates/>

While current trends do not necessarily explain its cultural role or how habits will evolve in the longer term, it is clear that **regular meat, dairy, and fish consumption is now a well-established part of diets and food cultures in many parts of the world.** Data from 2017 show that in the US, Australia, Argentina, New Zealand, and Spain, people eat more than 100kg of meat per annum.²⁶⁶ Meanwhile, in countries in West Africa and Asia, as well as several island states, fish represent 60% or more of total dietary protein.²⁶⁷ Meat consumption is also rising rapidly in Nigeria and across West Africa.²⁶⁸ Other countries can be expected to follow suit: several studies have established a correlation between economic development and growth in animal protein consumption, suggesting that as incomes rise, cultural norms change and people tend to include more meat in their diets^{269,270,271} – although these trends are influenced by industry and government policies (see below).

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

It is also clear that **cultures change regularly and rapidly** – and are ultimately a construct of socio-economic factors, values, and norms that are themselves in flux. This means that the conditions currently creating high/growing demand for meat cannot be assumed to be permanent, and future trajectories are in fact more uncertain and more malleable than they appear.

Firstly, the dietary shifts currently taking place in emerging and developing countries are being shaped by corporate strategies and government policies. Rapid economic growth and burgeoning middle classes in China,²⁷² India,²⁷³ and Brazil²⁷⁴ are amplifying demand for meat and (Westernized) processed foods. Here and elsewhere, these shifts are facilitated by the development of cold storage, increased exchange of perishable goods between urban and rural areas, and the classic patterns

of economic development. However, they are also part of deliberate corporate-led strategies to accelerate the consumption of animal source foods and create new cultural norms, in a context of stagnant demand for dairy, beef, and pork in wealthy markets. In particular, Westernization and “meatification” are being promoted in regions where these diets have traditionally been less central, and especially among households with rising incomes.^{275,276,277}

The geopolitical strategies and policy incentives put in place by governments have also helped to promote high consumption of animal source foods. In the Global North, agricultural surpluses – partly resulting from state subsidies – have long made meat and dairy products disproportionately cheap and abundant. In China, meanwhile, “dragon head” firms^{xxviii} have been designated to industrialize and consolidate agri-food industries in order to provide lower cost food to Chinese citizens – helping to spark rapid adoption of dairy into Chinese diets.²⁷⁸



Secondly, marketing campaigns have cemented regular consumption of meat as a cultural preference. Concerted efforts to mould cultural norms have underpinned the corporate growth strategies described above. A number of researchers argue that the link between modernity, class, economic development, and meat-eating has been heavily shaped by the agri-food industry.²⁷⁹ The various celebrations and rituals around meat consumption have been reinforced by marketing strategies.²⁸⁰ In some cases, cultural ‘myths’ have been perpetuated to further embed meat-eating habits. For example, in 2016, Cargill’s advertisements for American Thanksgiving included the tagline: “Honest. Simple. Turkey.” suggesting that turkey is an inherent part of this cultural tradition, and associated with other positive cultural values.²⁸¹

In particular, food industry marketing continues to reinforce long-held tropes about meat and masculinity in order to encourage high meat consumption among men (see Box 15).²⁸² Meat substitute manufacturers are now employing some of the same marketing strategies to emphasize the cultural importance of meat and thereby promote meat-like products.²⁸³ ‘Hyper-nudging’ techniques could soon be deployed systematically to influence consumer food choices,²⁸⁴ opening up new possibilities to boost meat consumption via cultural cues. A highly-specialized industry is already forming around these opportunities.^{xxix}

xxviii Dragon heads are enterprises that are responsible for opening up new markets, innovating, and advancing regional economic development by consolidating small-scale farms. They are supported by the Chinese government to help modernize the country’s agri-food system.

In Schneider, Mindi. “Dragon Head Enterprises and the State of Agribusiness in China.” *Journal of Agrarian Change* 17, no. 1 (2017): 3-21. 10.1111/joac.12151

xxix For example, Midan Marketing in the United States is a strategic meat marketing, research, and communications agency that is using social media and data analytics to promote meat to consumers.

In *Midan Marketing*. Accessed March 13, 2022. <https://www.midanmarketing.com/>

BOX 15**MEAT, MASCULINITY AND MARKETING**

As early as the 1870s, American media began to identify red meat as the province of men, and vegetables, fish, white meat, and desserts as ‘female foods’.²⁸⁵ These trends have become embedded in household/family rites in many regional contexts, including through allocations of bigger meat portions to men – ‘man-sized portions’.²⁸⁶ Meat has also been used to respond to a presumed crisis of masculinity.²⁸⁷ an analysis of contemporary fast food advertisements found that they created a dichotomy between male and female food – particularly meat vs. vegetables – in an attempt to counter flatlining meat consumption, with beef-eating positioned as a means of restoring hegemonic masculinity in the face of threats.²⁸⁸ The quest to “assert dominant masculinity and retrieve a lost sense of power, status, and prestige” has also driven alt-right groups to promote high meat consumption – although other factions have pursued abstention from meat for similar reasons.²⁸⁹

Thirdly, excessive meat consumption is enabled by the increasing disconnection of people from the realities of food production.^{xxx} Industrialization and vertical integration of meat production have made meat consumption easier than ever by removing the need for individuals and families to hunt, raise, slaughter, and/or process animals in order to eat their meat. Even the phytosanitary aspects of meat production are often hidden, with outbreaks of food-borne illnesses blamed on improper food handling by consumers or poor sanitation by workers, rather than considering the built-in risks to livestock production and processing at large scales.²⁹⁰ In countries like Nigeria, where meat consumption is rapidly rising, the domestic pastoralist systems that have met demand until now are giving way to more distanced large-scale production chains.²⁹¹ As one theorist has put it, ‘carnism’ – the practice of eating animals – is so widespread that the deliberate choice it represents and the ‘belief system’ underpinning it are effectively hidden, allowing meat-eating to feel like common sense.²⁹²

Finally, some of the values and norms underpinning meat consumption are now shifting rapidly. As described above, raising and eating animals has played a key role in shaping socio-cultural relations over millennia. However, modern-day norms around meat often come with a difficult historical legacy. For example, eating animals has shaped the histories of many colonial countries, including the US, where the role of cattle ranching shaped colonialism and settlement on the Great Plains and beyond.²⁹³

Furthermore, meat-eating patterns are associated with long-standing social hierarchies, power claims, and gender norms. Although there are notable counter-examples,^{xxxi} gender inequality (due to men typically obtaining meat via hunting), and species inequality^{xxxii} (embodied in the act of eating meat) appear to go hand in hand historically.^{294,295} Unequal food sharing within the home, and gender inequality in health outcomes, continue to this day and were exacerbated by the COVID-19 pandemic.^{xxxiii}

“New meat-eating norms could emerge - shaped neither by patriarchy nor by industrial food systems”

Nonetheless, values are shifting in many societies. This could mean higher net consumption of animal source foods as access to them becomes more equally distributed. But it could also mean a new set of social norms around meat – shaped neither by patriarchal traditions nor by the perverse incentives of industrial food systems.

xxx Disconnection has been observed on three levels: physical (between high-population urban zones and the rural zones where food is produced); economic (more intermediaries between consumers and farmers, with a greater share of value moving up the chain at the expense of farmers); and cognitive (decreasing knowledge of how food is produced and processed).

In Bricas, Nicolas, Claire Lamine, and François Casabianca. “Agricultures et alimentations : Des relations à repenser?” *Natures Sciences Sociétés* 21 (2013): 66–70. 10.1051/nss/2013084

xxxi In many traditional North American Indigenous communities, hunting was a group activity with men, women, and two spirited people all contributing to collective efforts to feed their communities.

In Slater, Sandra and Fay A. Yarbrough. *Gender and Sexuality in Indigenous North America, 1400-1850*. University of South Carolina Press, 2011.

xxxii A survey on over a hundred pre-industrial societies found that economies highly dependent on the processing of animals for food were characterized by gendered segregation in work activities, with women working more than men, but in less valued activities – including childcare.

In Sanday, Peggy. *Female power and male dominance: On the origins of sexual inequality*. Cambridge and New York: Cambridge University Press, 1981, 65-66.

xxxiii See, For example: Agarwal, Bina. “Imperatives of recognising the complexities: gendered impacts and responses to COVID-19 in India.” *Economia Politica* (2021). 10.1007/s40888-021-00242-8

The rapid growth of vegan and vegetarian diets in a number of high-income countries (see Section 1) shows how fast preferences can shift based on new values and evolving perceptions of animal source foods – with increased animal welfare, environmental, and health concerns clearly playing a role in reshaping diets, food habits, and food cultures.^{296,297} Although these trends are often dismissed as a white middle-class fad, there is growing evidence to suggest that vegan and vegetarian movements are also powerful vehicles for social/racial justice and resistance to existing power structures (see Box 16).

BOX 16

VEGANISM: MIDDLE-CLASS FAD OR VEHICLE FOR SOCIAL CHANGE?

While it has been suggested that veganism is shaped by neoliberal and colonial concepts of universalism, colour blindness, and consumerism,^{298,299} a growing number of researchers, activists, and chefs are challenging the belief that vegan diets are ‘race-blind’ or for women only.^{300,301,302} Instead, they present veganism as a means to decolonize diets away from Westernized, patriarchal, corporate influences to diets that are more affordable and connected to diverse food traditions and belief systems. For example, there is a growing culture of Black veganism in the US that builds on the traditions of Rastafarianism and is concerned about health and social justice for people of colour.³⁰³ Research in Argentina, which has a strong meat-eating culture, suggests that veganism and vegetarianism can be part of a counter-cultural resistance to gender norms for both men and women.³⁰⁴

WHAT CAN WE CONCLUDE?

In many parts of the world, regular consumption of meat, dairy, and/or fish is clearly a part of who we are. But those cultural identities and norms are in continual evolution, and are heavily shaped by corporate strategies and government imperatives. Current trends towards high consumption of animal source foods are a function of industrial agriculture, the promotion of Western-style diets, and heavy cultural marketing. The resulting habits are becoming embedded in the fabric of industrial and industrializing societies. But they do not (yet) constitute long-term cultural norms, despite the efforts of marketers to play on and augment cultural attachments to meat. Current meat-eating trends are only set in stone insofar as industrial food systems are too.



Vegan and vegetarian diets are growing rapidly in a number of high-income countries

The distance between people and food production may in fact be starting to narrow. Consumer awareness around the impacts of industrial livestock production is growing in light of major exposés, widely-viewed reportages, and documentaries, particularly in the wake of COVID-19. Counter-trends towards plant-based diets are growing fast. High meat consumption may in fact be out of step with emerging cultural values – and thus due for a major realignment.

CLAIM 5

**“‘ALTERNATIVE PROTEINS’
ARE A WIN-WIN-WIN
FOR ANIMALS, PEOPLE,
AND THE PLANET.”**



IN SUMMARY

Plant-based meat, dairy, and fish substitutes, as well as lab-grown meat, are being rapidly developed and rolled out, based on bold claims about their ability to reduce environmental impacts, improve diets, and spare animals from being farmed and slaughtered. 'Alternative proteins' may improve individual sustainability indicators in direct comparisons with their industrially-produced equivalents. However, the evidence to date is limited and speculative (particularly for lab-grown meat). The implications for health and sustainability ultimately depend on what ingredients are used, how they are produced and processed, as well as what they are replacing and where they are being marketed. Many of the latest substitutes rely on energy-intensive hyper-processing to produce key additives, as well as sourcing ingredients from industrial monoculture systems. 'Alternative proteins' also represent a new phase of food system industrialization that could undermine resilience, jeopardize the livelihoods of millions of food producers, and reinforce a 'centre of the plate' approach to diets – rather than supporting transformational changes in the way we eat. Bold and categorical claims about alternative proteins being a 'win-win-win' are therefore misleading.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Alternative protein industries; some vegetarian/vegan organizations, animal welfare groups; investors, influencers; meat processors (investing in alt. proteins); media coverage of studies and new products

WHAT IS DEFINED AS THE PROBLEM?

The environmental, health, and animal welfare impacts of animal source foods

WHAT IS THE PROPOSED SOLUTION?

Partial or complete replacement of animal source foods with plant-based substitutes and/or lab-grown meat

WHAT ISSUES ARE LEFT OUT?

Labour and livelihoods; resilience; innovation systems, lock-ins, and power relations; holistic diet and food system change

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

Concerns about the sustainability of animal source foods, and particularly livestock farming, are widespread (see Claim 3). While some are optimistic about the ability of new technologies to reduce the environmental impact of livestock farming (see Claim 7), others are arguing for conventional animal source foods to be substituted by ‘alternative proteins’, including novel plant-based substitutes (also known as ‘meat mimics’ and ‘meat analogues’), lab-grown (cultured) meats, and insect-based foods (See Box 17). These products have been promoted based on the promise of wide-ranging benefits for animals, people, and the planet. For example, Impossible Foods claims that the Impossible Burger requires “87% less water and 96% less land, and generates 89% less GHGs” than conventional beef burgers.³⁰⁵ Similar **reductions in environmental footprint** are claimed by Beyond Meat in relation to its plant-based burger^{xxxiv} and by JUST for its plant-based eggs.^{xxxv}

With a complete array of essential nutrients, plant-based meat substitutes have also been presented as **healthy and high-quality alternatives** to animal source foods and some whole plant-based foods.^{306,307} Meanwhile, lab-grown meat has been touted as “**victimless meat**” on the grounds of its potential to reduce animal suffering; in the absence of intensive animal confinement, manufacturers also argue that lab-grown meat reduces the spread of pathogens, zoonotic diseases, and AMR, thereby **increasing food safety and reducing environmental health risks**.³⁰⁸

Building on these assertions, **some of the most vocal claim-makers have called for ‘alternative proteins’ to replace conventional animal production systems** – “the most destructive technology on the planet”^{xxxvi} – in their entirety, or at least in wealthier nations. Bill Gates, for example, has declared that “all rich countries should move to 100% synthetic beef”.³⁰⁹

In particular, lab-grown meat has been touted as the path towards ‘rewilding’ agricultural landscapes and moving towards landless production systems – including by influential environmentalists,³¹⁰ agenda-setting private institutions and investors,^{xxxvii} scientists, and alternative protein manufacturers³¹¹. Others are arguing that ‘alternative proteins’ can act as a stepping stone to help reluctant consumers to move away from meat, with some lab-grown meat companies targeting a more modest displacement of purchases among high meat-consuming populations.^{xxxviii}

Almost all of those promoting ‘alternative proteins’ reiterate the unique potential of newly meat-like substitutes and lab-grown meat to drive rapid dietary shifts, in light of cultural attachments to animal source foods (see Claim 4). Perceived global protein needs (as described in Claim 1) are never far from the discussion of ‘alternative proteins’. For example, a 2013 report from the FAO suggested that scaling up insect farming was necessary to address “the rising cost of animal protein, food and feed insecurity, environmental pressures, population growth, and increasing demand for protein among the middle classes”.³¹²

While independent studies are still fairly scarce (see below), **the manufacturers and promoters of ‘alternative proteins’ have generated considerable data to support their claims**. Claims about their climate impacts versus conventional livestock are particularly well-documented.^{313,314} A study tracking the GHG emissions associated with 39 meat substitutes estimates that these foods generate approximately 10 times fewer GHG emissions than comparable beef-based products.³¹⁵

Land use savings are a key part of the climate calculus: one study compared livestock with a number of alternatives – including insects, fish, soy-based meat substitutes, and lab-grown meat – and found that the greatest land use savings (based on feed conversion efficiency)^{xxxix} came from replacing animal source products with soybean curd, followed by mealworms.³¹⁶

xxxiv “Unlike their 1/4 lb US beef counterparts, original Beyond Burgers can be made by generating 90% fewer greenhouse gas emissions”. Beyond Meat. “Mission.” Accessed March 13, 2022. www.beyondmeat.com/about/

xxxv “Our plant-based JUST Egg uses 98% less water, has a 93% smaller carbon footprint and uses 86% less land than conventional animal sources.” In JUST Egg. “Learn” Accessed March 13, 2022. www.justegg.com/learn

xxxvi CEO of Impossible Foods.

In: Friend, Tad. “Can a burger help solve climate change?” *The New Yorker*. September 23, 2019. <https://www.newyorker.com/magazine/2019/09/30/can-a-burger-help-solve-climate-change>.

xxxvii Influential investors including Richard Branson and Bill Gates are promoting and investing in a range of ‘alternative protein’ firms.

In Morgan, Rick. “Bill Gates and Richard Branson are betting lab-grown meat might be the food of the future.” *CNBC*. March 23, 2018. <https://www.cnn.com/2018/03/23/bill-gates-and-richard-branson-bet-on-lab-grown-meat-startup.html>

xxxviii For example, the founders of VOW Foods have gone on record saying that lab-grown meat can share shelf space with plant-based and traditional meat sources.

In Berry, Kim. “Cell-cultured kangaroo meat start-up granted \$25k.” *Food & Drink Business*. August 20, 2019. <https://www.foodanddrinkbusiness.com.au/news/cell-cultured-kangaroo-meat-start-up-granted-25k>

xxxix Measured in terms of the dry matter weight of feed requirements per unit of edible weight (kg DM feed/kg EW).

WHAT ARE 'ALTERNATIVE PROTEINS'?

Plant-based substitutes – also referred to as 'analogues' or 'meat mimics' – are based on replacing animal-derived ingredients/foods with plant-based ingredients,³¹⁷ while simulating the taste, sight, smell, touch/feel, and chemical characteristics of traditional meat products. In other words, they deliberately attempt to mimic the taste and texture of animal-sourced foods like burger patties, ground or shredded meat, and sausages.³¹⁸ Plant-based analogues range from the 'Impossible Burger' to egg substitutes made from algae-based powders, and longer-standing products like *Quorn* that are derived from mycoprotein.^{xl} Numerous consumer reviews have underlined the success of novel plant-based substitutes in mimicking a meat-like appearance, texture, flavour, and mouthfeel.³¹⁹ The novel substitutes are clearly distinct in their design and composition from traditional/established plant-based preparations which are sometimes used as meat replacements (e.g. tofu, tempeh, seitan, texturized vegetable protein, simple veggie burgers), and whole foods which are sometimes seen to approximate the experience of eating meat (e.g. jackfruit, mushrooms, beans).

Lab-grown meat – also called cellular, in vitro, artificial, cultured or 'clean' meat – is based on growing meat cultures derived from one animal (via unfertilized eggs from a female animal) or from a series of animals (stem or satellite cells obtained from a living or dead animal).^{320,321} Lab-grown foods made frontpage news in 2020 when Eat Just's lab-grown chicken became the first cellular product in the world to be approved for consumption by the Singapore Food Agency.³²² A number of other lab-grown products – including fish, eggs, and dairy – are also under development.

While insect consumption is relatively common for at least 2 billion people worldwide, novel (processed) **insect-based 'protein' products** for human consumption have become more mainstream over recent years, bringing insects to new regional markets. Insects have a high feed conversion rate compared to animals and are highly nutritious. Insects are already widely-approved as feed in various jurisdictions, and are now being authorized for human consumption in a number of countries. Manufacturers are hoping that successes in marketing insect-based pet food as an alternative to meat could help to change perceptions and drive up human consumption among non-accustomed populations.³²³ When it comes to marketing insect-based proteins, most companies use powders and bars.

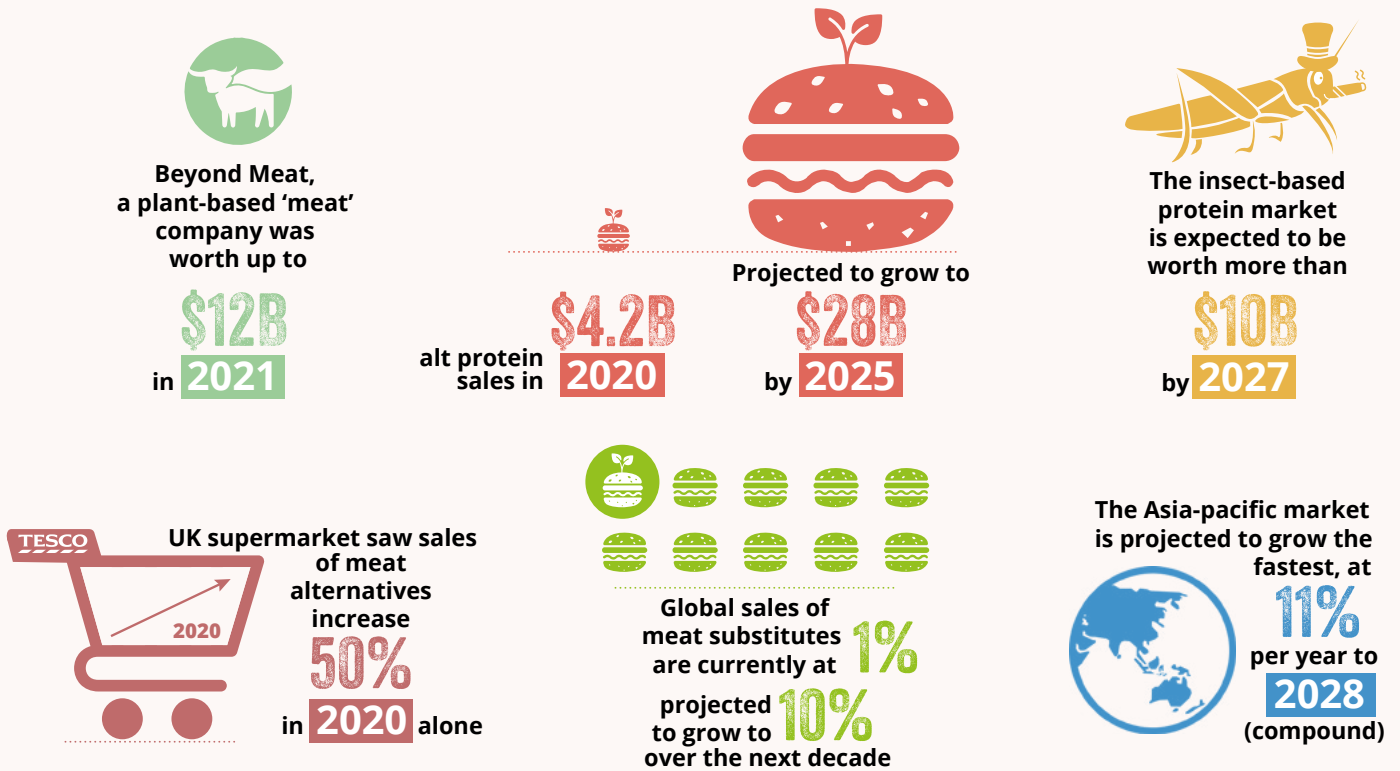
While data on lab-grown foods remains highly speculative (see below), most studies to date suggest major GHG savings. In particular, the sustainability credentials of lab-grown fish have been stressed by the industry-backed Good Food Institute on the grounds of reduced energy requirements due to fish having lower body temperatures and simpler muscular structure than mammals/birds.³²⁴ Data on the efficiencies of insect production are particularly compelling. Since insects are cold-blooded, they are 12-25 times more efficient than livestock at converting their food to protein.³²⁵ Insects can be fed waste material, further reducing GHGs through decomposition.³²⁶

There is also considerable documentation of the claimed health and nutrition benefits of 'alternative proteins'. Plant-based analogues are generally low in total and saturated fat, and – in contrast to meat – provide a source of dietary fibre.³²⁷ For example, data from Impossible Foods shows that the Impossible Burger contains no cholesterol, more bioavailable protein (31%) and iron (25%), and less fat (18%) than a conventional '80/20'^{xli} beef burger.³²⁸ According to some studies, the ratio between saturated fatty acids and polyunsaturated fatty acids in lab-grown meat could easily be recalibrated to provide a healthier product; similarly, saturated fats could be replaced by other types of fats, including omega-3s.³²⁹

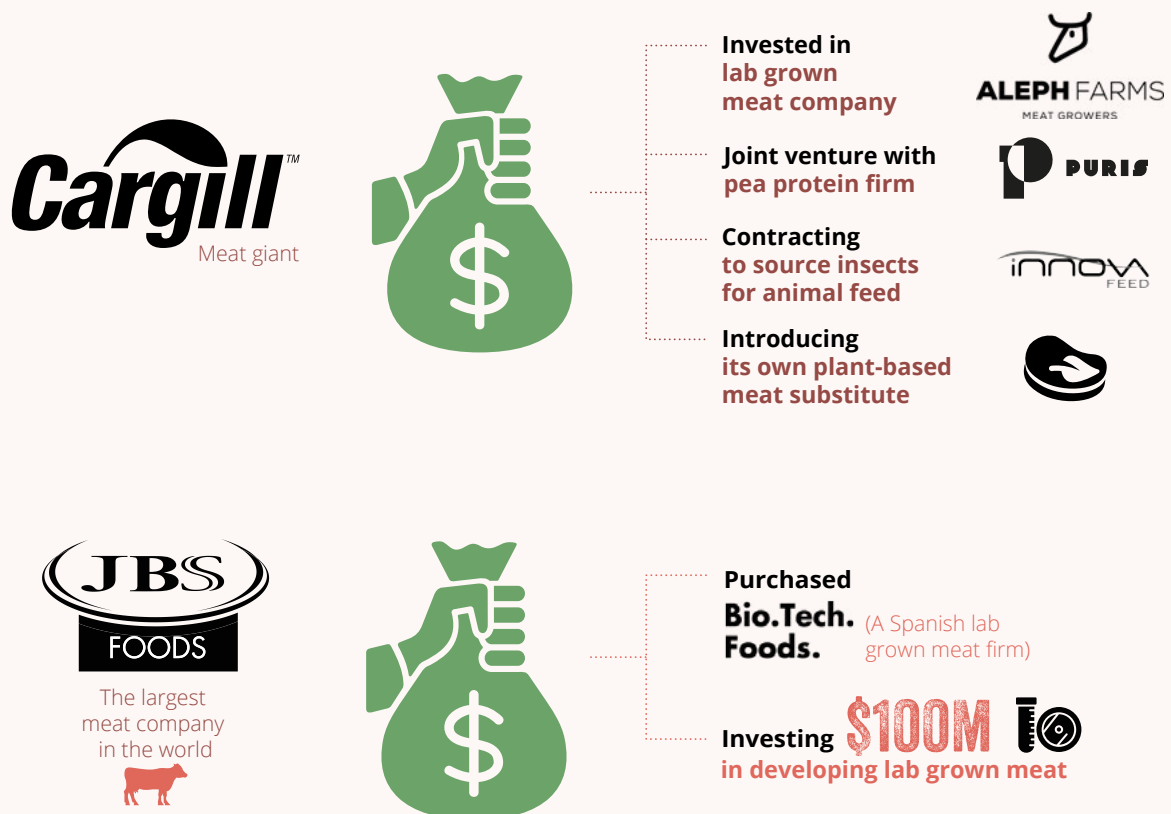
xl Mycoprotein products are based on fermentation technology of a naturally occurring fungus, *Fusarium venenatum*, mixed with egg albumen. Mycoprotein, marketed under the brand name Quorn, was launched in the UK in 1985 and is now available in 14 countries.
xli 80/20 refers to meat that is 80% lean and 20% fat.

FIGURE 10

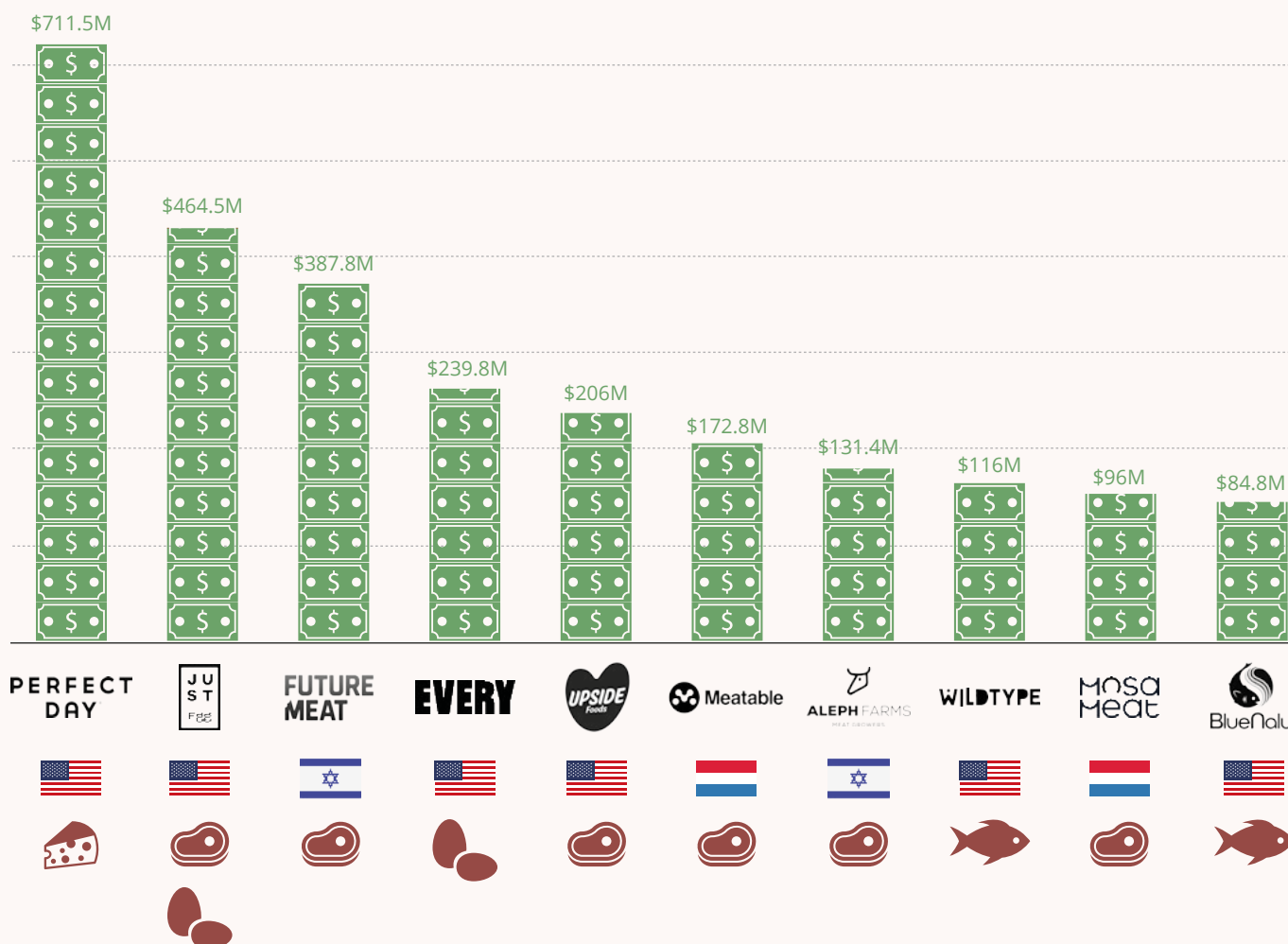
'ALTERNATIVE PROTEINS' ARE BIG BUSINESS AND GROWING FAST IN ASIA, EUROPE AND THE AMERICAS



BIG MEAT COMPANIES ARE MOVING INTO PLANT-BASED SUBSTITUTES



THE 10 LARGEST LAB-GROWN MEAT (AND FISH/DAIRY/EGG) FIRMS IN FUNDING RAISED FROM FUNDING ROUNDS



WHY IS THIS CLAIM POTENTIALLY MISLEADING?

Firstly, some claims about ‘alternative proteins’ are based on unsubstantiated science and misleading assumptions. As noted above, research in this area is dominated by studies which the manufacturers have funded, commissioned, contributed to and/or undertaken, in particular for lab-grown meat, which is yet to be mass-commercialized.³³⁰ This has led to the unsubstantiated hyping of a number of alternative protein breakthroughs.

For example, the bacteria-based protein powder developed by Solar Foods, Solein, has been described by its manufacturer as “100 times more efficient in converting energy to calories than animals”,³³¹ but there does not appear to be any publicly available data to substantiate the claim. Meanwhile, one of the first studies to compare lab-grown and conventional hamburgers concluded that the overall environmental impacts of lab-grown meat production were substantially lower than those from conventional sources³³² – including 78-96% less GHG emissions – but the study used the environmentally-friendly cyanobacteria as the growth medium, while all manufacturers appear to be using fetal bovine serum (FBS).^{xlii}

xlii With the exception of some lab-grown fish companies that are working to find alternatives to FBS.

In Purdy, Chase. *Billion Dollar Burger: Inside Big Tech's Race for the Future of Food*. Penguin Random House, 2020.

Fundamental questions about nutrient intake and value from processed plant-based substitutes and lab-grown meat also remain unresolved (see Box 18), making it hard to justify bold claims about the nutritional benefits of ‘alternative proteins’. Although the animal welfare benefits of shifting to ‘alternative proteins’ are irrefutable, claims about lab-grown meat being completely “victimless” or “slaughter-free”^{xliii} do not reflect the state of scientific knowledge in this field.^{333,334,335}

BOX 18

ARE ALL NUTRIENTS EQUAL? UNCERTAINTIES ABOUT THE NUTRITIONAL BENEFITS OF ‘ALTERNATIVE PROTEINS’

While the nutrient profiles of some popular plant-based substitutes effectively mimic the nutrient count of comparable meat products, isolated plant proteins, fats, vitamins, and minerals may not provide the same nutritional benefits as nutrients that occur naturally in whole foods – with research still limited in this field.³³⁶ Meanwhile, there is no guarantee that lab-grown meat will contain the same micronutrient profile as animal products (such as vitamin B12 and iron). It is also uncertain whether the biological compounds in lab-grown meat will have the same positive and synergistic effects as conventional meat products on human health. Uptake of micronutrients by lab-grown cells has yet to be fully understood. Chemical additives may be required to ensure that lab-grown meat contains comparable nutritional value to its conventional counterpart – making it less ‘clean’ than originally claimed.^{337,338}

Secondly, and relatedly, many of the potential benefits of ‘alternative proteins’ are highly uncertain and speculative. The market-leading plant-based substitutes are evolving fast and represent a moving target. For example, in response to criticism over salt content, Beyond Burger moved quickly to release a new plant-based burger in early 2021, with less salt and less saturated fat than both the Impossible Burger and 80/20

beef burgers.³³⁹ Many new meat substitutes fall into the category of ultra-processed foods,^{xliv} whose consumption is recommended to be limited by a number of dietary guidelines.^{xlv} A 2019 analysis from the Harvard Medical School found that the health benefits of legumes used in a range of meatless burgers were somewhat diminished by their high degree of processing, high levels of sodium, and comparable levels of saturated fats.³⁴⁰ Meanwhile a UK survey found that meat-free burgers sold by three supermarkets – Tesco, Asda and Sainsbury – contained more salt on average than meat burgers.³⁴¹

“Fundamental questions about nutrient intake & value from processed plant-based & lab-grown meat remain unresolved”

Furthermore, projections about lab-grown meat are riddled with uncertainties. One recent study concluded that the potential of lab-grown meat to cut GHG emissions is contingent on the decarbonisation of energy systems, in light of its high energy requirements; the complexity of comparing CO₂-only lab systems with the combination of methane, nitrous oxide, and CO₂ in livestock systems also clouds the picture.³⁴² Uncertainties regarding the potential by-products from lab-grown meat further complicate the task of developing comparative emissions data.³⁴³ Some of the claims around scaling insect-based foods for human consumption are also hypothetical. For example, the black soldier fly is one of the most commonly farmed insects in the world, but because it commonly eats waste materials in the larval stage, it has not been approved for human consumption in any jurisdiction.^{xlvi}

Thirdly, the sustainability benefits of ‘alternative proteins’ depend on what they are made of and how those ingredients are produced. Sustainability calculations for plant-based substitutes are sensitive to variations in methodology, system boundaries, and underlying assumptions, e.g. about the composition of

xliii The most likely practice in lab-grown meat is the harvesting of primary cells from live animals. Although less than 100 animals would theoretically be needed to continuously line new meat cells, a recent study found that a minimum herd size of 20,000 would be required to maintain population genetics. Another way to source cell material is by establishing so-called immortal cell lines, but technical challenges in maintaining the health of these cells remain a significant barrier to commercial success. Meanwhile, sourcing animal cells via unfertilized cells – which qualifies as a genetically modified organism and could be regulated as such – remains understudied, and requires more long-term safety testing. In Purdy, Chase. *Billion Dollar Burger: Inside Big Tech's Race for the Future of Food*. Penguin Random House, 2020.

xliv Ultra-processed foods are defined as formulations of ingredients, mostly of exclusive industrial use, typically created by a series of industrial techniques and processes (hence ‘ultra-processed’) (i.e. carbonated soft drinks; sweet, fatty or salty packaged snacks; candies (confectionery); mass produced packaged breads and buns, cookies (biscuits), pastries, cakes and cake mixes).

In Monteiro, Carlos Augusto, Geoffrey Cannon, Mark Lawrence, Maria Laura da Costa Louzada, and Priscila Pereira Machado. *Ultra-processed foods, diet quality, and health using the NOVA classification system*. Rome: Food and Agriculture Organization of the United Nations, 2019.

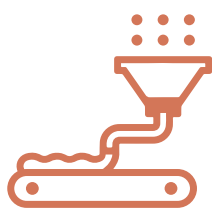
xlv Dietary guidelines from Belgium, Brazil, Ecuador, Israel, Maldives, Peru, and Uruguay specifically mention “ultra-processing.”

In Koios, Daniela, Priscila Machado, and Jennifer Lacy-Nichols. “Representations of Ultra-Processed Foods: A Global Analysis of How Dietary Guidelines Refer to Levels of Food Processing.” *International Journal of Health Policy and Management*. (2022). 10.34172/ijhpm.2022.6443.

xlvi Authorization of most edible insect products remains a legislative ‘grey area’.

In Bessa et al., “Why for feed and not for human consumption?”

those products.³⁴⁴ For example, soy- and wheat-based substitutes have been found to have a much larger environmental impact than other raw products, such as lupin, from which several plant-based substitutes are now derived.³⁴⁵ How plant ingredients are produced also matters. Chemical-intensive crop monocultures are already driving severe environmental and health impacts across food systems.³⁴⁶ Plant-based analogues may exacerbate these problems by sourcing ingredients from industrial chains. For example, coconut and palm oil are key ingredients in many new meat analogues – and industrial production of these commodities is associated with deforestation and ecosystem disturbances in biodiversity-rich tropical regions.³⁴⁷



Many new meat substitutes fall into the category of ultra-processed foods

Further, the use of genetically modified ingredients in some plant-based substitutes, e.g. the heme and soy protein used by Impossible Burger, also raises health concerns (as a novel food), and environmental concerns, centring in the latter case on the use of glyphosate on herbicide-resistant soy crops.

BOX 19

WOULD POST-LIVESTOCK LANDSCAPES REALLY BE 'REWILDED'?

The purported benefits of reducing/eliminating livestock can only be realized if the land that is spared is turned to sustainable uses or 'rewilded', provided that food needs can be met elsewhere. But shifting from one land use to another cannot be taken for granted. For example, one meta-study found that while cropland increased more slowly than population over 1970-2005, there were few cases of higher yields leading to a 'paired' decline in cropland either nationally or globally; the study therefore concluded that "future projections of cropland abandonment and ensuing environmental services cannot be assumed without explicit policy intervention".³⁵⁵ Similarly, claims that lab-grown fish or plant-based fish substitutes will lead to rewilding of the sea need to be robustly examined with regard to historical precedent. Aquaculture has long been touted as a way of relieving pressure on the oceans and the pathway to restoring marine ecosystems. Although wild fisheries catch has stabilized in spite of ongoing population growth, it has not been dramatically downsized as a result of aquaculture, and over-fishing remains rife in many fisheries/regions (see Claim 6). Furthermore, claims about rewilding/restoration often fail to consider the rights of Indigenous peoples and other communities as users and stewards of land and marine resources.

Although some manufacturers have made sustainable sourcing pledges,^{xlvii} it is far from guaranteed that their many assorted ingredients will be sourced from sustainable, diversified systems – particularly as manufacturers seek to bring down costs. More comprehensive assessments of meat substitutes have also shown that the degree of processing – and the associated resource and energy requirements – is an important determinant of their sustainability.³⁴⁸

Fourthly, the sustainability benefits of 'alternative proteins' depend on which animal production systems they are compared against. As shown in discussion of Claim 3, there is huge variation between the impacts and implications of different types of livestock and different production models. Research that has distinguished between different types of meat has found significant variation, with one recent study finding that some novel meat substitutes have higher GHG emissions and energy use than poultry products.³⁴⁹ LCAs have also identified a higher water footprint for a number of substitutes in comparison to certain animal source foods, depending on the main source of plant protein (e.g. mycoprotein versus gluten or soy).³⁵⁰ Studies also suggest that the blue water footprint of lab-grown meat is higher than most farmed meat production, but lower than pig meat and pond-raised aquatic animals.³⁵¹ While a handful of studies have also distinguished between different types of animal production systems (e.g. organic, grass-fed, multi-paddock),³⁵² many rely on binary comparisons between plant-based analogues/lab-grown meat and industrial livestock – particularly beef.^{353,354} Furthermore, claims about the benefits of substituting meat with alternatives tend to rely on land currently occupied by livestock (or feed crops) being turned to plant-based food production, spared, or 'rewilded' – assumptions that need to be unpacked (see Box 19).

xlvii See, for example: Impossible. "Impossible Foods: Supplier Code of Conduct. Accessed March 13, 2022. <https://impossiblefoods.com/ca/suppliers/responsibility>

Fifthly, ‘alternative proteins’ are concentrating ever-greater power in the hands of centralized production systems and dominant firms – thereby posing major risks to resilience and sustainability in the long run.^{356,357} One study has described the future large-scale production of lab-grown meat as “a new phase of industrialization with complex and challenging trade-offs” as well as unforeseen risks.³⁵⁸ For example, keeping contamination out of lab-grown meat may prove a challenge in a context of large-scale factory manufacturing and long-distance transport of end products.^{359,360} Even if rare, failures stemming from the complex technological systems of lab-grown meat production are surely inevitable.³⁶¹ Even the scaling of insect and seaweed protein is likely to generate complex trade-offs and unforeseen consequences, with new farmed seaweed species potentially resulting in decreased biodiversity and increased disease risks.³⁶²

“ Alternative proteins are concentrating ever-greater power in the hands of dominant firms ”

Market developments are also concerning. While a number of start-ups initiated the alternative protein boom, the market is increasingly dominated by a handful of ‘protein giants’ – and tied into the investment strategies of opaque financial players like BlackRock and Vanguard (see Figure 11). Only large, powerful firms are likely to be able to do what it takes to remain competitive in the lab-grown meat sector – from gathering the technical knowledge to ploughing capital into R&D and accessing government subsidies and grants.³⁶³ Monopolies are being created and barriers erected, with Memphis Meats and SuperMeat filing numerous patents on lab-grown meat technologies.^{364,365} Similar developments are occurring in the insect protein sector, where France-based Ÿnsect has raised over \$425 million in investments and filed 300 patents on its vertical insect farming processes.³⁶⁶

These risks and trade-offs can potentially be managed, with some seeing potential for lab-grown meat to unleash new power relations and a new policy environment.³⁶⁷ However, the emerging political economy of the ‘protein sector’ raises major questions about how these technologies can be scaled out in the public interest.

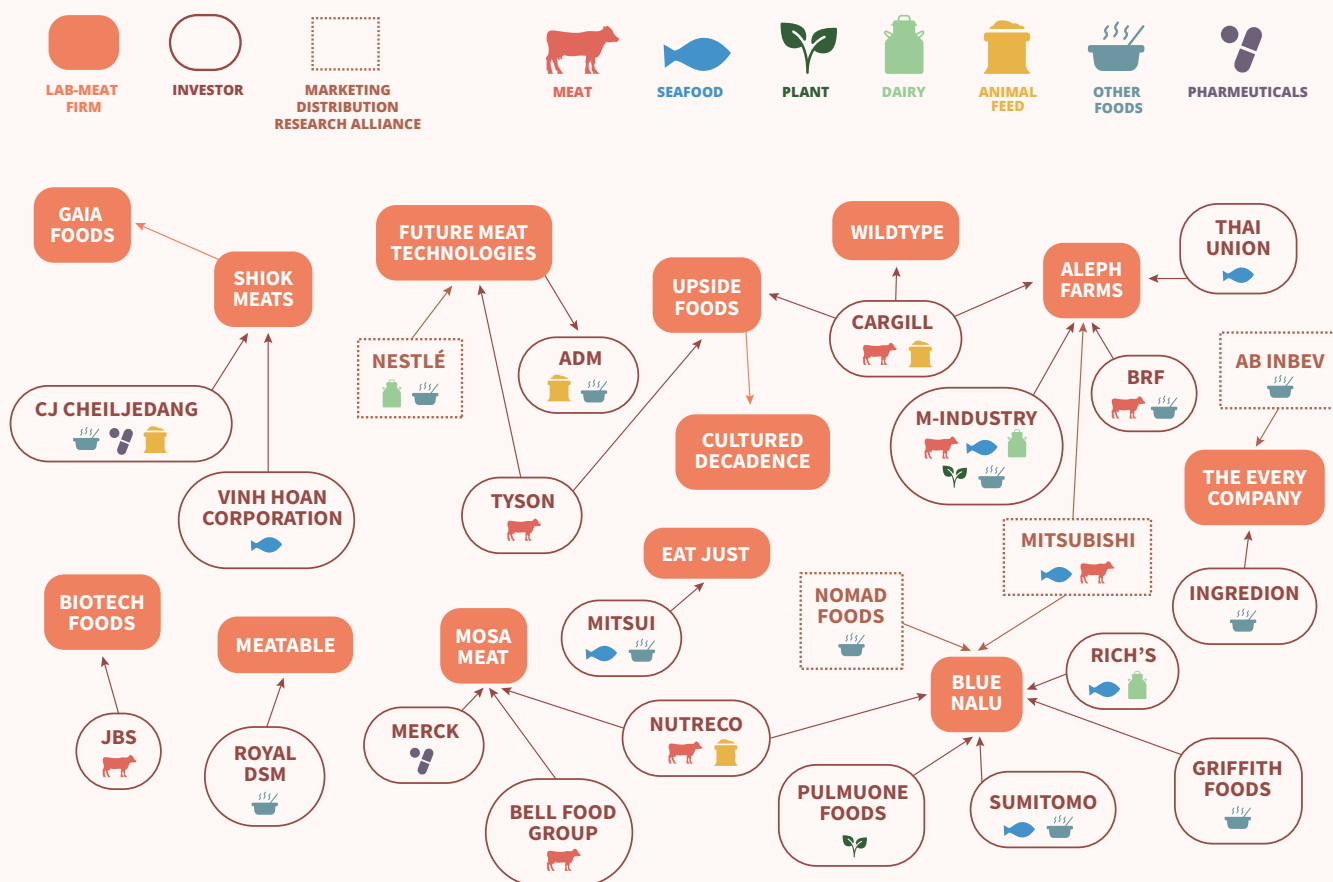
“ The shift to cell-based meat production could entail a significant overhaul of labour in the protein production sector ”

Finally, ‘alternative proteins’ could displace and disrupt the livelihoods of millions of people, including some of the world’s poorest. A rapid transformation of the agricultural marketplace from farmed to cell-based meat production could entail a significant overhaul of the labour force, from farmers, farmworkers, meat processors, and veterinarians, to chemists, cell biologists, engineers, and factory and warehouse workers.^{368,369}

Although farmers and farmworkers would still be needed to produce raw ingredients or inputs for ‘alternative proteins’, a significant reduction in livestock would lead to massive layoffs and unemployment in the livestock farming and meat processing sectors, as well as driving a major restructuring of rural communities and landscapes. It remains unclear how many new jobs would be created by lab-grown meat industries,³⁷⁰ and it appears unlikely that the education and skills required to work in these industries would overlap with current jobs in the meat industry. In many parts of the Global North, farmworkers and meat processing workers are often migrant labourers, creating further obstacles to a ‘just transition’ in these industries.

Although alternative protein industries have initially targeted wealthier markets, manufacturers already have their sights set on rollout across the Global South (see Section 1) – making it all the more urgent to consider the implications for the billions of people worldwide whose livelihoods depend on agriculture. Such concerns are raised infrequently in mainstream media coverage and in academic literature, reflecting their reliance on industry sources, and the general tendency to present overwhelmingly positive perspectives on emerging technologies.³⁷¹

THE LARGEST LAB-GROWN MEAT FIRMS AND THEIR INVESTORS



In conclusion, there are too many uncertainties and data gaps, and too much variation between systems, to make a definitive statement on whether ‘alternative proteins’ are more environmentally sustainable than animal source foods as a whole.³⁷² Bold and categorical claims about ‘alternative proteins’ being a ‘win-win-win’ are therefore likely to be misleading. Claims of this nature echo the bluntest approaches in existing studies, brush over important nuances in the literature, and ignore the

realities of highly-diverse plant and animal production systems. The validity of claims about ‘alternative proteins’ (and the purported benefits of these products) ultimately comes down to how foods are produced, what food systems we consider to be desirable and viable, how we weigh up trade-offs (e.g. between short-term CO₂ reductions and long-term threats to livelihoods and resilience), and what knock-on effects are assumed as new and disruptive products are scaled up and rolled out – questions that will be revisited in Section 3.

CLAIM 6

**“WITH WILD FISH CAPTURE
STAGNATING, AQUACULTURE
PRODUCTION SHOULD
BE INCREASED.”**



IN SUMMARY

Fish/seafood are significant sources of nutritious food for more than 3 billion people. With wild fish capture stagnant for decades, aquaculture has increasingly been promoted as a sustainable way to raise fish production, address the 'protein gap', and meet broader nutritional needs. However, the impacts of aquaculture systems vary substantially, depending on the species cultivated, external input requirements (e.g. fish feed), forms of containment, and political-economic context. Input-intensive, single-species systems are growing fast and generating a range of negative impacts. Promoting aquaculture in general terms gives a green light for further expansion of production models that threaten food security and sustainability – and thus contribute to the problems they are supposed to solve. Addressing aquaculture through a global protein-centric lens also means overlooking the holistic benefits of ecological aquaculture (e.g. multi-trophic systems), and ignoring the needs of many communities around the world for whom small-scale fisheries and aquaculture systems are a source of livelihoods and healthy, sustainable diets.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Aquaculture industries; marine scientists; conservation groups; governments and international organizations

WHAT IS DEFINED AS THE PROBLEM?

Wild capture fisheries are unsustainable and more protein- and micronutrient-rich foods are required

WHAT IS THE PROPOSED SOLUTION?

Continued expansion, upscaling and technological enhancement of aquaculture, particularly input-intensive, single-species production

WHAT ISSUES ARE LEFT OUT?

Livelihoods; environmental contamination, resource depletion and knock-on effects on food security; ecological aquaculture models; power relations

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

Increasingly, **aquaculture is promoted as a sustainable way to increase protein production and deliver food security.** Claims about the potential of aquaculture generally contrast fish-farming systems with the sustainability problems and stagnating catch of wild fisheries – sometimes advocating a transition from “capture to culture”. In 2021, the Director-General of the FAO stated that aquaculture is vital for feeding the world’s expanding population, as well as providing important economic opportunities in vulnerable communities.³⁷³ According to Mai Kangsen, an aquaculture advisor to the government of China, aquaculture is “the most efficient way” to reconcile food security with resource constraints.³⁷⁴ In calling for new technological innovations to enhance the productivity of large-scale aquaculture, the industry has argued that these systems are necessary to feed growing populations^{375,376} or for sparing wild fish populations.³⁷⁷ Furthermore, aquaculture is often positioned as an answer to problems that cannot be resolved in land-based food production. For example, in a 2018 communication entitled ‘A Clean Planet for All’, the European Commission argued: “In order to alleviate the multiple demands on the EU’s land resources, improving the productivity of aquatic and marine resources will play an eminent role in capturing the full range of opportunities of the bio-economy for tackling climate change.”³⁷⁸

More Than
80% 
of fisheries are fully fished
or overfished

The shift towards aquaculture is well underway: **aquaculture is increasing as a source of food, while wild capture fisheries is not.** Promoters of aquaculture point to the fact that catch and consumption of wild fish has been stagnant for decades, despite a geographic expansion farther offshore, at deeper levels and including smaller, previously ignored species.³⁷⁹ Models suggest there has been a decline in biomass since the 1950s in 17 of 18 climatic zone-ocean basin groupings.³⁸⁰

More than 80% of assessed fisheries are fully fished or overfished,³⁸¹ and are vulnerable to the increasing power and efficiency of capture technologies, such as GPS and sonar.³⁸² Climate change is another threat, and 10-60% of fish species consumed by humans are expected to struggle to reproduce by 2100, depending upon the degree of temperature increase.³⁸³

In this context, **proponents of aquaculture point to its contribution in filling the gap and allowing fish consumption to keep rising.** Since 2000, aquaculture has increased at annual growth rates of more than 5%, and was estimated to produce 50 million metric tonnes (mmt) of edible fish, crustaceans, and molluscs in 2015.³⁸⁴ Of the 171 million tonnes of fish consumed in 2016, 47% was from aquaculture,³⁸⁵ although estimates are complicated by less accurate data on inshore and artisanal fishing.^{386,387} As much as 90% of global aquaculture (by volume) is located in Asia, with more than 50% in China alone.³⁸⁸

Calls for ongoing expansion of aquaculture are also rooted in clear evidence on the **critical role of fish in food and nutrition security.** As well as delivering protein, fish are abundant in vitamins, minerals, and essential fatty acids, and play an important role in child growth and development in many populations, meaning that a reduction in consumption would likely have substantial negative impacts.^{389,390} Globally, fish accounts for 17% of animal source food intake, but the figure rises to 29% in low income countries.³⁹¹

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

Claims about aquaculture tend to be misleading in one key way: they fail to recognize the huge differences in scale, structure, and impacts between different types of production systems. Like for livestock (see Claim 3), the spectrum of aquaculture systems is vast, ranging from lower density systems with few inputs, to energy-intensive production units relying on inputs sourced from great distances. The cultivation of fish and other aquatic organisms has been practiced for thousands of years, including in what is now Egypt, China, and Mexico.³⁹² Production is still characterized by numerous smallholders, but this is changing as governments increasingly promote large-scale and industrial forms of aquaculture.³⁹³ Most of the recent growth in aquaculture is accounted for by single species, input-intensive fish-farming at higher trophic levels, particularly high-valued, carnivorous finfish such as tuna, salmon, and cod. Although ‘unfed’ systems also continued to expand, they declined from 43.9% of aquaculture production in 2000 to only 30.5% in 2018.³⁹⁴

A highly-concentrated aquaculture industry has taken root, dominated by a small number of firms for high value species.³⁹⁵ For example, one Norwegian firm, Mowi, controls approximately 18% of the global farmed salmon market.³⁹⁶ These firms also receive substantial government subsidies: the EU was projected to spend 2.89 billion euros (\$3.16 billion) on subsidies for aquaculture from 2000 to 2020, even though production stagnated during this period.³⁹⁷

The failure to disaggregate these systems leads to debates in which a number of key questions are overlooked. **Firstly, ‘aquaculture’ is being framed as a solution to global food system challenges – but dominant commercial aquaculture models are part of the *problem*.** The ecological and socio-economic impacts of aquaculture depend on the species cultivated, form of containment, biogeography, and their cultural and political-economic context. Intensive aquaculture systems at high trophic levels place considerable pressure on ocean and land-based resources, and contribute to a number of food security, health, and sustainability concerns in global food systems. Although a shift towards more sustainable feed composition is underway, the total pressures on wild-caught fish are likely to remain high (see Box 20).

Furthermore, high stocking density is linked to high usage of antibiotics, anti-fouling agents, and other inputs, as well as generating high concentrations of nutrients in waste. Salmon farmers in Chile, for example, are estimated to use up to 950 grams of antibiotics per tonne of fish, which likely exceeds any other fish or livestock industry in the world,³⁹⁸ and may contribute to antibiotic resistance. In addition, an emphasis on single, high-value species, particularly genetically uniform varieties, may lead to a greater susceptibility to parasites and diseases. As a result, a growing number of salmon farms are incorporating other species such as wrasse and lumpfish to help control sea lice.³⁹⁹

Other impacts of aquaculture may include destruction of coastal habitats, such as the deforestation of mangroves for shrimp aquaculture, and fish escapes, which have detrimental effects on wild fish due to competition, interbreeding, and the spread of parasitic and infectious diseases.⁴⁰⁰ A key hotspot for large and frequent fish escapes, for example, is Southern Chile, the location of the world’s largest net-pen aquaculture of non-native salmon and trout.⁴⁰¹ Claims in this area therefore have a circular logic: aquaculture may be a solution to stagnating wild fish capture, but through its fish feed requirements and its contribution to the degradation of marine environments, aquaculture is one of the factors undermining wild fish populations.

BOX 20

THE HEAVY FOOTPRINT OF FISH FEED, AND OPPORTUNITIES FOR REDUCING IT

Most aquaculture LCAs suggest that at least 90% of GHG emissions are due to feed inputs.⁴⁰² Common feeds for carnivorous and omnivorous fish species include small ocean-caught fish, such as sardines, anchovies, and mackerel, 90% of which are suited for direct human consumption.⁴⁰³ In West Africa, for example, an increasing number of factories process these species into fishmeal and fish oil for export to China, the EU, and Norway, diverting the fish from local communities.⁴⁰⁴ Approximately 4% of feed crops globally are also used in aquaculture, shifting impacts back from sea to land.^{xlviii} Motivated in part by rising costs, efforts are successfully lowering the amounts of fish required for feed inputs. This is occurring through selective breeding, and by formulating more plant and microbial ingredients: the percentage of fish in salmon feed in Norway, for example, declined from approximately 90% to 25% between 1990 and 2016.⁴⁰⁵ Due to the lower energy required to move in water, fish are more efficient than pigs and cattle in converting feed to weight gain, but do not retain as much protein from feed as chicken.⁴⁰⁶ Further efficiencies could be derived from shifting to insect-based fish feed: insects are already a common food for many fish species and using farmed insects to feed fish would be attainable for many small-scale enterprises.⁴⁰⁷ The rapid expansion of more intensive forms of aquaculture, however, means that in spite of these trends, aggregate pressure on wild caught fish may continue to increase, with aquaculture accounting for an increasing share of fish oil and fishmeal consumption (approximately 73% in 2010).⁴⁰⁸

xlviii Plant-based feed inputs used in aquaculture also have potential negative effects, particularly soy, which may be grown on recently cleared rainforest soils and shipped great distances (see Claim 3), such as from Brazil to Norway, thus shifting impacts from sea to land. Omnivorous species, such as shrimp, tilapia, catfish, and most kinds of carp typically receive a high percentage of soy in fed aquaculture diets.

In Malcorps, Wesley, Björn Kok, Mike van't Land, Maarten Fritz, Davy van Doren, Kurt Servin, Paul van der Heijden, Roy Palmer, Neil A. Auchterlonie, Max Rietkerk, Maria J. Santos, and Simon J. Davies. "The sustainability conundrum of fishmeal substitution by plant ingredients in shrimp feeds." *Sustainability* 11, no. 4 (2019). 10.3390/su11041212

Secondly, framing the debate around increasing net production obscures the real challenge: to shift to different types of aquacultures at different trophic levels. Innovations in ecological aquaculture, particularly those that apply agroecological principles, have the potential to overcome the problems described above and deliver positive socio-economic and ecological outcomes⁴⁰⁹ (see Box 21) – but these solutions receive insufficient attention in a context where aquacultural systems are rarely disaggregated. Instead, discussion is framed around innovations to enhance productivity, efficiency, and/or scale⁴¹⁰ – solutions framed as necessary to feed growing populations^{411,412} or for sparing wild fish populations.⁴¹³

One firm, Mowi, controls

18%

of the global market
for farmed salmon



These include: 1) offshore or open ocean mariculture, 2) recirculating aquaculture systems (RAS) or land based aquaculture, 3) digital technologies, such as drones, sensors, robots and artificial intelligence, 4) genetic engineering to increase growth rates and feed conversion efficiency, and 5) feed from algae or insects. The Nature Conservancy, for example, is promoting investments in offshore mariculture and RAS.⁴¹⁴ Significant problems with these technologies remain, however, such as substantial energy use, escape in open ocean mariculture, concentrated waste in RAS, and unintended breeding effects. As some scholars have noted, “silver bullet, techno-scientific solutions to problems... originating in bigger socio-structural processes [are] a one-dimensional solution to a multidimensional problem”⁴¹⁵ (see also Claim 7 for discussion of broader claims around technological innovation).

Thirdly, the focus on aquaculture as a universal solution for meeting global protein needs means that the holistic benefits delivered by smaller-scale, traditional aquaculture systems are regularly overlooked.

90%

of the fish used as aquaculture
feed is suitable for direct
human consumption



Small- and medium-scale aquaculture frequently have positive community impacts on food security, employment, and wages – although in some contexts value can be captured by more powerful actors.⁴¹⁶ In Myanmar, for example, small commercial fish farms were reported to generate substantially higher incomes and more indirect benefits to local economies than crop farms.⁴¹⁷ Aquacultural systems that are integrated into shorter supply chains also reduce fossil fuel use at other stages of the food system, and are less vulnerable to disruption.⁴¹⁸ Small-scale aquaculture does not necessarily mean more sustainable practices, however, as some producers may use excessive fertilizers or antibiotics.⁴¹⁹

“Intensive aquaculture systems
place considerable pressure on ocean
& land-based resources”

Small-scale, integrated aquaculture models have little representation in the policy arena, and low visibility to consumers. Third party certifications, such as Aquaculture Stewardship Council and Friend of the Sea, currently exclude most inshore and artisanal operations – although there are plans to include more in the future.

BOX 21**POLYCULTURES, MULTI-TROPHIC AQUACULTURE, AND INTEGRATED AQUACULTURE-AGRICULTURE SYSTEMS**

‘Unfed’ or ‘non-fed’ systems most commonly produce various types of carp or bivalve molluscs (mussels, clams, oysters, scallops), as well as aquatic plants. Polycultures of four different carp species that inhabit different trophic levels have been used for more than a thousand years in China to increase the productivity of non-fed aquaculture.⁴²⁰ Integrated multi-trophic aquaculture (IMTA) is a term created in 2004 to describe long-standing practices, such as co-culturing kelp, bivalves, and finfish in the same system,⁴²¹ with productivity and nutrient mitigation measures that exceed traditional polyculture.⁴²² Systems that increase the linkages between terrestrial and aquatic food production are called integrated aquaculture-agriculture (IAA). These may include stocking fish in rice fields, and/or using manure (e.g. ducks or pigs) as pond fertilizer to increase productivity. High labour requirements and the introduction of feed pellets have contributed to the decline of IAA in China,⁴²³ although systems based on these models have been successfully adapted to other regions. Cultural preferences for seafood have reinforced unsustainable consumption of high trophic level species, although a number of chefs, campaigners, and public authorities are now seeking to revalue lower trophic level species.^{424,425}

WHAT CAN WE CONCLUDE?

It is clear, therefore, that the failure to differentiate between different types and scales of aquaculture leads to highly generalizing discourse and misleading claims in this area. Promoting aquaculture in general terms effectively gives a green light for further expansion of models of aquaculture that threaten food security and sustainability – and thus contribute to the problems they are supposed to solve. The grouping of fisheries/aquaculture with other animal source foods and novel products under the banner of ‘proteins’ is also problematic.

“While promoted as an alternative to wild fish capture, aquaculture is in fact one of the factors undermining wild fish populations”

The problems and solutions as formulated by ‘protein companies’ and advocates of a global ‘protein transition’ simply do not apply to, nor offer any benefits for, the many communities around the world for whom small-scale fisheries and aquaculture systems are a source of livelihoods and healthy, sustainable diets. Part of the challenge, therefore, is to find a way to protect these livelihoods and diets *and* to find new ways to talk about fish (and more broadly about higher protein foods and sustainability) that make these distinctions and nuances clear.

CLAIM 7

**“TECHNOLOGICAL ADVANCES
CAN RAPIDLY REDUCE
THE NEGATIVE IMPACTS
OF LIVESTOCK.”**



IN SUMMARY

Technological innovations are often highlighted as a means to reduce the impacts and enhance the productivity of industrial livestock systems. The 'precision livestock' packages and new breeding approaches being marketed by agribusinesses may deliver initial gains, but they also reinforce the uniformity and density of production units – creating a treadmill of environmental and epidemiological risks, sparking problems further down the line (often with a time lag before they are visible), and undermining resilience. Furthermore, 'techno-fixes' also tend to be designed for large-scale, highly-capitalized farms, ignoring the needs of smaller producers. These innovation pathways are therefore unlikely to substitute a wider reform of food systems – and tend to shift the focus away from systemic questions.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Agribusinesses; livestock producer associations; meat processors; global agri-development partnerships

WHAT IS DEFINED AS THE PROBLEM?

Problems with animal source food production are technical issues

WHAT IS THE PROPOSED SOLUTION?

Better breeding techniques, precision livestock, digitalisation, waste digesters, vaccines, etc.

WHAT ISSUES ARE LEFT OUT?

System redesign around diversification and agroecology; path dependencies and opportunity costs; small-scale and pastoralist livestock systems

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

While livestock is often portrayed as fundamentally unsustainable (see Claim 3), there are also prominent (counter-)claims suggesting that new technologies can dramatically reduce the sector's environmental impacts. Proponents of livestock technological innovation claim that current production methods are antiquated and highly inefficient, while **new technologies and innovations would make it possible to produce meat in a sustainable way**.⁴²⁶ The Gates Foundation, USAID, some policy-makers at the FAO, and the Consultative Group on International Agricultural Research (CGIAR) are among the many prominent policy actors backing the potential of technology to revolutionize livestock and increase productivity.⁴²⁷ In the context of developing countries, the push for adoption of large-scale livestock farming and the accompanying technologies tends to be framed around *modernization*. For example, in discussing West African pastoral systems in the context of rising meat demand, the director of the Institute for International Research on Livestock Farming (ILRI), stated: "All we need is to modernize it."⁴²⁸

Claims in this area are often linked to specific innovation pathways for industrial feedlots – in particular the 'precision livestock farming' packages which are being touted as a route to environmental, economic, and social sustainability (see Box 22).⁴²⁹ Companies like Cargill are developing these technologies for the "protein production chain" and promoting this "digital disruption" as a way to rapidly transform the animal production industry.⁴³⁰ Retailers are also touting the sustainability of their supply chains on the basis of technologically-enhanced livestock systems. For example, the "verifiable sustainable beef" pilot project from McDonald's champions tools like advanced hormones and targeted antibiotics in line with the retailer's pursuit (and definitions) of "animal health," "food safety," and "production efficiency".⁴³¹ Meanwhile, the Agriculture Innovation Mission for Climate (AIM4C) initiative – a multi-country partnership initiated by the US and UAE governments with a number of corporate partners – is investing over \$5 million in reducing enteric methane emissions from cattle via selective breeding, feed additives and supplements, and AI monitoring,⁴³² arguing that "new technologies, products, and approaches are required to mitigate and adapt to climate change while supporting growth and jobs".⁴³³

BOX 22

PRECISION LIVESTOCK FARMING AND NEW BREEDING TECHNIQUES

- 'Precision livestock' technologies include real-time data about animal health, nutrition and location, mobile data applications providing information on animal size, weather and dissolved oxygen levels (for fish), data from herd management systems, and facial recognition of animals and animal nutrition optimization, with aims of improving animal health, reducing antibiotic use, and increasing efficiency.⁴³⁴ Overall, the precision livestock farming market was estimated to be worth \$3.1 billion in 2020 and as much as \$4.8 billion by 2025, thanks to a compound annual growth rate of 9%.⁴³⁵
- Significant investment is going into **new breeding techniques**, with a focus on increasing tolerance to large-scale confinement, accelerated growth on less feed, and thus reduced land requirements, risks, and associated environmental impacts.⁴³⁶
- **Gene drives** are also being researched as a pathway to improved livestock breeding. A paper using pigs as an example concluded that "gene drives could be used to increase the speed at which edited gene variants are spread across livestock populations". The authors recommend gene drives as an efficient breeding tool for spreading new CRISPR alterations.⁴³⁷

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

The claims made in this area are not patently false. Technological innovations *can* reduce specific negative impacts of livestock systems. However, they tend to focus on narrowly-defined problems – often problems created by the last round of technological innovations – while reinforcing an industrial livestock system that is fundamentally unsustainable (see Claim 3).

Firstly, developing solutions through the lens of technological innovation prioritizes the needs of capital-intensive, large-scale farms. Solving food system challenges through technology is a deeply-established political preference and worldview,⁴³⁸ and extends beyond livestock debates. A key dimension of that worldview is the assumption that solutions must work at scale. This has led to innovation pathways that overlook the needs and interests of smaller and more diversified production units. For example, anaerobic digesters to reduce GHG emissions from livestock manure have been subsidized in California, with plans to expand this policy to the rest of the US,⁴³⁹ – but mid- and small-scale operations cannot afford the \$3-5 million in capital costs to construct a digester, nor do they produce enough waste to be economically feasible.⁴⁴⁰ Similarly, recombinant bovine growth hormone (rbGH) was developed with public funding, and its adoption in the US dairy industry increased milk production at a time when there was already an excess of supply, reinforcing a treadmill effect that lowered milk prices and drove smaller scale dairies out of business. New data-driven precision livestock innovations are likely to reinforce these trends by steering users toward more expensive inputs and larger-scale operations, reinforcing the use of industrial livestock breeds, and incurring high costs for switching between data platforms.^{441,442,443}

“ Technological innovation in food systems has often led to innovation pathways that overlook the needs & interests of smaller, more diversified producers **”**

Secondly, many of the latest livestock technologies are explicitly aimed at increasing density and intensifying production, thereby building up future risks and threatening resilience. For example, 13-storey pig breeding facilities developed in southern China have been touted as a solution for urban food security – with enhanced surveillance and other measures meant to reduce disease and regulate production. However, the further concentration and intensification of production is what creates favourable conditions for the amplification and spread of pathogens,⁴⁴⁴ requiring complex, costly, energy-intensive, and sometimes ineffective surveillance systems. Meanwhile, livestock vaccines are often put forward as a solution to porcine epidemic diarrhea virus, avian influenza, and other livestock disease risks. However, two recently detected new variants of African swine fever in Asia are suspected to be the result of administering unapproved, genetically engineered vaccines.⁴⁴⁵ In general, disease risks are increased by conditions that suppress immune systems, life cycles that are shorter and more uniform, lack of on-site reproduction to evolve resistance, and increased global trade in livestock.⁴⁴⁶ In other words, industrial livestock systems and the latest ‘techno-fixes’ are creating an “epidemiological Jevons paradox” whereby any gains from adoption are offset by the facilitation of catastrophic disease outbreaks.⁴⁴⁷

Thirdly, breeding approaches sometimes increase the frequency of injury and sickness in animals, causing them undue suffering as well as undermining the supposed productivity gains for farmers. Control and manipulation of living organisms invariably poses a series of risks, which are often poorly understood at early stages of technological development. For example, keel bone fractures are becoming increasingly common as laying hens are bred to produce larger eggs.⁴⁴⁸ Meanwhile, the double-muscling Belgian Blue Beef (BBB) cattle breed has been selected to improve muscle structure and deliver high yield. However, this has come at the cost of a number of genetic disorders, resulting in higher mortality, routine cesarean sections, and difficulties in feeding calves.⁴⁴⁹ Somatic cell nuclear transfer technology also frequently results in offspring with health complications.⁴⁵⁰

Fourthly, sustainability claims often focus on technologies that are still in development, and are therefore highly speculative. Technologies gain attention when they reach a ‘peak of inflated expectations’ – with purported benefits that may never materialize,⁴⁵¹ and risks that are often under-explored. For example, estrogens, androgens, progestins, and other anabolic steroids are being widely applied in the beef cattle industry to enhance productivity and food safety.⁴⁵²

However, there is growing evidence to suggest negative impacts on human health, and major uncertainties about the effects of long-term exposure to several exogenous compounds, such as environmental pollutants, dietary hormones and additives – i.e. conditions that would seem to justify ‘precautionary’ approaches.⁴⁵³ While Gene Drive Organisms (GDOs) fall under the Cartagena Protocol on Biosafety and the national laws implementing it, regulatory gaps remain and are of major concern, given the risks of adverse environmental, health and socio-economic impacts associated with GDOs.⁴⁵⁴ The considerable time lag before negative impacts are typically observed and documented means that problematic technologies continue to be hyped even as they are malfunctioning on the farm.



Protein-focused firms have been prominent in recent cases of alleged price-fixing

.....

Finally, the track record of the firms advancing the latest ‘techno-fixes’ for livestock raises questions about their commitment to build more just and sustainable food systems. A number of leading meat and protein firms are continuing to pursue anti-competitive practices and an underlying supply chain model that disempowers producers and workers. For example, processors such as Tyson and JBS are extending their contract model to other regions and to more species of livestock, although this model has had negative impacts on the incomes and decision-making power of chicken growers in the Southern US.^{455,456,457}

Furthermore, COVID-19 increased awareness of the vulnerability of low-paid workers in meat and seafood processing units, many of whom were at greater risk of infection due to long working hours and inadequate access to safety protection and health care.⁴⁵⁸

Protein-focused firms have also been prominent in recent cases of alleged price-fixing, including in the tuna, beef, pork, chicken, turkey, and peanut sectors.⁴⁵⁹ Hormel, Tyson, and JBS, along with WH Group and other dominant firms in the US, have faced multiple accusations of anti-competitive behaviour, facilitated by sharing data with the firm Agri Stats, Inc. This includes driving up prices for distributors, retailers, and consumers, compressing workers’ wages and driving down farmgate prices for contract farmers. Although Tyson and JBS have paid hundreds of millions of dollars in fines or settlements for some of these claims, a number of legal actions are still ongoing, including federal indictments of ten poultry firm executives – five from JBS subsidiary Pilgrim’s Pride, and one from Tyson – relating to abuse of market power.⁴⁶⁰

WHAT CAN WE CONCLUDE?

In sum, claims based on techno-optimism are telling only a small part of the story and offering an illusory pathway to sustainability. The innovation pathways being advanced would reinforce industrial agriculture on every level, with its bias towards large-scale producers, its treadmill of environmental and epidemiological risks, and its highly unequal power relations. Further, the expectation that breakthrough technologies can achieve food system sustainability has the effect of sidelining already existing viable ecologically-based alternatives that allow for potentially more immediate, significant, and safe sustainability gains.⁴⁶¹ In Section 3, we discuss how innovation can be reimagined in the sustainable food systems of the future.

CLAIM 8

**“REGENERATIVE LIVESTOCK
SYSTEMS CAN SOLVE
ENVIRONMENTAL PROBLEMS
LIKE CLIMATE CHANGE
AND SOIL DEGRADATION.”**



IN SUMMARY

According to a range of increasingly vocal actors, shifting large numbers of animals into rotational grazing systems is the answer to livestock's environmental problems. The evidence confirms that efficiencies can be gained by dedicating marginal lands to livestock, with well-managed, pasture-based systems showing considerable soil carbon sequestration potential. However, some claims about the potential of 'regenerative livestock management' and 'carbon farming' risk overstating the ability of soils to store carbon, while separating GHG mitigation from other interconnected challenges (e.g. biodiversity loss). Meanwhile, corporate-led schemes reduce regenerative agriculture to a universal 'management fix' and lack the holistic vision and structured support that farmers would need to redesign production systems. More generally, calls for regenerative-led transition can ignore the historical legacies of land inequalities and social equity. In sum, discourse around regenerative livestock solutions may simply serve to justify high levels of production/consumption of animal source foods into the future.

WHO IS MAKING, USING, AND PROMOTING THIS CLAIM?

Large landowners & livestock producers; major food processors, manufacturers & retailers; influencers, investors; carbon credit businesses; some civil society organizations

WHAT IS DEFINED AS THE PROBLEM?

Soil degradation, climate change & industrial feedlots

WHAT IS THE PROPOSED SOLUTION?

Rotational grazing and regenerative management, allowing for CO₂ sequestration in degraded soils

WHAT ISSUES ARE LEFT OUT?

Limits of CO₂ sequestration in agriculture; climate responsibility of other (extractive) sectors; social and political challenges, including complexities of land use and colonial legacies

WHO IS MAKING THE CLAIM AND ON WHAT GROUNDS?

A global movement around 'regenerative agriculture' has emerged over recent decades, with close links to the organic, permaculture, and agroecological movements (see Box 23). More recently, a vision of 'regenerative' livestock management has taken shape, highlighting that "it's not the cow, it's the how." Numerous individuals, organizations, and corporations argue that mob grazing, rotational grazing, and other forms of intensive, short-duration pasture production of cattle (and other livestock, although mostly ruminants) can sequester carbon in the soil.

In particular, **striking claims about the climate potential of regenerative livestock management systems have been made by a number of charismatic communicators.** In a 2013 TED Talk, Allan Savory, the founder of Holistic Management and the Savory Institute, stated that rotational grazing at a large scale "can take enough carbon out of the atmosphere and safely store it in the grassland soils for thousands of years".⁴⁶² Savory went on to claim that only the use of intensive grazing with livestock can reverse desertification.⁴⁶³ Meanwhile, Gabe Brown, a well-known advocate of regenerative agriculture, has suggested that he has increased soil organic matter from 1.9 % to 6.1% in 20 years without the use of synthetic fertilizers or pesticides, via extensive perennial root systems in degraded grassland areas.⁴⁶⁴ Furthermore, the 2020 film *Kiss the Ground* suggested that by increasing soil organic matter on agricultural soils by 0.4%, regenerative livestock systems could sequester enough carbon to negate all current CO₂ emissions. Big claims about regenerative agriculture/livestock have been amplified by the health and wellness community,⁴⁶⁵ alongside promotion of the health benefits of a full meat diet, and pro-hunting advocacy.⁴⁶⁶

Today, the potential of regenerative agriculture/livestock is being promoted in the boldest terms by multinational food retailers and manufacturers, as they introduce 'regenerative' sourcing guarantees and sustainability schemes – notably in the dairy sector.

For example, General Mills is promising to "advance regenerative agriculture on 1 million acres of farmland by 2030"⁴⁶⁷ while Maple Leaf Foods, Nutrien, and Indigo Ag are partnering to "reward grain farmers in our animal feed supply chain who adopt regenerative agriculture practices and increase soil carbon sequestration on their farms".⁴⁶⁸ The growing interest in 'carbon farming' and 'climate farming' – sometimes seen as synonyms for regenerative agriculture^{xlix} – has brought further attention to farm/livestock management approaches focused on soil organic carbon.

“ Livestock raised in pastoralist systems are highly efficient in terms of edible protein produced per kg of edible protein consumed ”

These claims draw on **clear evidence about the potential for well-managed extensive livestock systems to make efficient use of marginal land.** A vast amount of agricultural land is presently unfit for crop production (e.g. too hilly, rocky, or forested), and ruminant systems on this marginal land are more productive than crops.⁴⁶⁹ Pastoralists often base their livelihoods in these environments, feeding their animals on vegetation that is inedible for humans. Livestock raised in pastoralist systems therefore has high 'efficiency' in terms of edible protein produced per kg of edible protein consumed, or in terms of available biomass.⁴⁷⁰ While food-feed competition is a major problem in some regions and production systems, grass and leaves make up 46% of livestock diets globally.⁴⁷¹ The significant quantity of non-human-digestible phytomass (i.e. plant material) found in grasslands and croplands suggests that scale-appropriate livestock systems are an efficient use of resources in these environments.

xlix According to the Carbon Cycle Institute, "Carbon farming is synonymous with the term "regenerative agriculture" when that term is explicitly rooted in an understanding of the underlying system dynamics and positive feedback processes that actually make a "regenerative" upward spiral of soil fertility and farm productivity possible." In Carbon Cycle Institute. "What is Carbon Farming?" Accessed March 13, 2022. www.carboncycle.org/what-is-carbon-farming/

WHAT IS REGENERATIVE AGRICULTURE AND HOW DOES IT COMPARE TO OTHER APPROACHES?

The term 'regenerative' was first used in the 1970s by Robert Rodale, of the Rodale Institute, but its contemporary usage draws on principles from holistic management and permaculture.⁴⁷² Regenerative agriculture emphasizes supporting agroecosystems by protecting soils, incorporating trees and perennial plants, and including animals in cropping systems.⁴⁷³ Proponents of regenerative agriculture often cite the concepts of rotational grazing established by Allan Savory in the 1960s in his work in Zimbabwe restoring degraded soils through intensive, short-lived grazing.⁴⁷⁴ Using biomimicry to simulate the patterns of wild herds of herbivores that roam the world's grasslands, rotational grazing in particular emphasizes the interactions between predator and prey. Stampedes of animals would stomp on the soil and disturb it so that rain can penetrate more easily, without causing compaction through overuse. These patterns were also seen with pastoralists herding animals frequently from one area to another.⁴⁷⁵ In North America, the large herds of bison that roamed the grasslands and would stampede to escape predators are often cited as evidence that large herds of cattle are good for the environment and need to be reconstituted. Regenerative agriculture also draws on permaculture principles suggested by Bill Mollison and David Holmgren in the 1970s, although there is less emphasis on perennial crops and agroforestry. Both emphasize healthy soils and the importance of maintaining permanent soil cover and integrating organic matter into the soils through practices including conservation tillage, composting, cover crops, crop rotation, and pasture cropping.⁴⁷⁶ The scale of permaculture is often limited to gardens, while regenerative agriculture is generally targeted at larger farms. Permaculture places a central importance on trees and other perennial crops, but these are not emphasized in regenerative agriculture, which focuses more on ways of making monocultural agriculture more sustainable. Agroecology overlaps with regenerative agriculture in terms of some key aims and principles;¹ nonetheless, agroecology is generally articulated as part of a broader vision for building social justice and democratic food systems.⁴⁷⁷ All of these approaches draw directly from Indigenous knowledge and practice.

There is also growing evidence to suggest that **grazing land can sequester and store carbon from the atmosphere more effectively than other land uses.**^{478,479,480} By contrast, feed monocropping systems rely on extensive tillage practices which release carbon back into the atmosphere.⁴⁸¹ Although ruminant production emits GHGs (including CO₂, CH₄ and N₂O), animal grazing can stimulate carbon sequestration in soils.⁴⁸² Good livestock management practices such as adaptive multi-paddock systems, a core component of regenerative livestock production, have the potential to reduce GHG emissions through soil carbon sequestration, and the finishing phase of livestock can in some cases be a net carbon sink.^{483,484}

In particular, **reductions in GHG emissions** can be delivered by integrating animals with new tree growth,^{485,486} and by including forage and ruminants in regenerative managed agro-ecosystems in a way that increases the organic carbon content of the soil and minimizes the need for tillage.⁴⁸⁷ One study found that grass-fed beef delivered nutrients significantly more efficiently than feedlot-produced beef, in terms of GHG emissions/gram of Omega-3 fatty acids.⁴⁸⁸ Additional GHG savings can be delivered by replacing high-energy synthetic fertilizers with manure (see below).^{489,490}

Further, **claims about regenerative systems are underpinned by powerful evidence on the contributions extensive livestock can make in closing soil, water, nitrogen, and phosphorus cycles,** and fertilizing organic arable production without having to resort to chemical fertilizers. If animals are stocked on land appropriately, and water is also available in more than one location, then there is less compaction and manure is well distributed.⁴⁹¹ Globally, around 22% of total nitrogen and 38% of phosphate applied on the soil is of animal origin, over half of which comes from beef cattle. Manure contributes more to soil health and fertility than the use of mineral fertilizers alone.⁴⁹² Integrated livestock systems have also been shown to help to **protect and rebuild biodiversity** by improving soil ecological function in a way that minimizes use of inorganic fertilizers and biocides.⁴⁹³ These benefits are particularly associated with agro-silvo-pastoral systems that support **reforestation and afforestation** programmes, where animals are grazed in forested areas.⁴⁹⁴

¹ See, for example: IPES-Food, IFOAM - Organics International, Agroecology Europe, FiBL Europe, Regeneration International. "A unifying framework for food systems transformation: A call for governments, private companies & civil society to adopt 13 key principles." July 2021. http://www.ipes-food.org/_img/upload/files/sfsEnhq.pdf

Integrating livestock and crops is also an important source of **diversification of revenue**, and thus a key factor in building resilient farming livelihoods.⁴⁹⁵ Given their documented benefits and efficiencies models of conversion to organic or agroecological production systems often include **reintegrating crops and livestock at a regional scale**, not least to address nitrogen scarcity in the absence of increasingly expensive synthetic fertilisers.^{496, 497, 498, 499, 500}



Integrated livestock systems can help to protect & rebuild biodiversity

WHY IS THIS CLAIM POTENTIALLY MISLEADING?

Well-managed extensive livestock therefore has high potential to be part of sustainable and resilient production systems. However, while regenerative agriculture was initially modest in its claims to restore degraded soils, some of the bolder claims now being made tend to overstate the benefits and play down complexities, uncertainties, and context.

Firstly, soil is now being touted as a panacea for climate change despite the difficulties in measuring soil carbon sequestration, and the dangers in separating CO2 mitigation from other challenges. Reliable ways of measuring soil carbon sequestration are still lacking.^{501, 502} The amount of carbon that grasslands can store depends on how much carbon is already there, as sequestration stops when saturation is reached and losses due to leaching, microbial respiration, and other processes begin to take effect.⁵⁰³ After a few decades, some soils have been found to reach carbon equilibrium whereby no additional carbon is accumulated.⁵⁰⁴ Grassland soils only actively sequester carbon when they are recovering from serious degradation, or in conversion from arable land to pasture.

Once grasslands have reached a mature state, the carbon going into soil is equal to the carbon exiting the soil.⁵⁰⁵ For example, the above-mentioned documentary *Kiss the Ground* did not address how benefits would be maintained over time as peak soil organic carbon levels are reached. Furthermore, there is some debate as to whether or not soils will retain carbon if there is not also sufficient nitrogen, phosphorus, or sulfur – and concerns that these minerals may be better used to grow food than stored in soils.^{506, 507} In regard to specific claims made by Gabe Brown regarding soil organic matter, for which only observational evidence has been provided, some 215kg of nitrogen and 21kg of phosphorus would need to have been produced per acre per year, in addition to what would be needed to produce a crop or raise livestock on that same soil.⁵⁰⁸

Big claims about the climate mitigation potential of sustainable livestock systems therefore risk creating unrealistic expectations about the role agriculture can and should play in addressing the climate crisis, while allowing pollution to go unabated in other sectors – despite the many existing problems with carbon markets and offsets.

“ Civil society organizations are warning of the dangers of separating the climate crisis from the collapse of biodiversity ”

Inflated claims also risk over-emphasizing CO2 at the expense of other interconnected challenges. Responding to the European Commission’s recent ‘carbon farming’ proposals, a group of civil society organizations warned of the dangers of separating the climate crisis from the collapse of biodiversity, arguing that agroecological approaches are the only way to “reduce greenhouse gas (GHG) emissions, increase carbon sinks, restore biodiversity, and increase resilience simultaneously”.⁵⁰⁹

Secondly, regenerative agriculture is at major risk of co-option and dilution as it is rapidly adopted by the agri-food industry.⁵¹⁰ The big promises mentioned above have often been made without a demonstration of the principles of regenerative agriculture and without specific context or evaluative methods to ensure that they are having the intended effect. A recent survey by the World Benchmarking Alliance found that only 6% of companies claiming to be pursuing regenerative approaches to increase soil health and agrobiodiversity have evidenced their commitments with quantitative data or set company-wide targets.⁵¹¹ The definition of regenerative agriculture employed by General Mills includes understanding the local context, keeping the soil covered, minimizing soil disturbance, maximizing crop diversity, maintaining living roots in the ground year-round, and integrating livestock; but in its 2021 Global Responsibility Report, General Mills acknowledges that it does not currently have metrics to assess whether or not suppliers are ‘achieving’ regenerative agriculture.⁵¹² This is despite the fact that in 2017, the Regenerative Organic Alliance established a certification based on soil health, animal welfare, and social fairness.⁵¹³

Only
6%
of companies claiming to use
regenerative approaches
have evidenced their
commitments with data or set
company-wide targets

Beyond livestock, there are also clear signs that regenerative agriculture is used to cover a whole range of cropping systems (see Box 24). There is therefore a risk that regenerative livestock approaches be reduced to a universal ‘management fix’ and used by corporations to greenwash their activities. It is worth noting that a growing number of corporations and organizations have also attempted to co-opt agroecology to diminish its influence and water down its calls to action.⁵¹⁴

BOX 24

IS REGENERATIVE AGRICULTURE BEING USED AS A SYNONYM FOR NO-TILL AGRICULTURE?

Regenerative agriculture often includes practices that can be integrated into conventional agriculture systems, such as no-till agriculture. Furthermore, recent converts to regenerative agriculture, including major corporations, often do not mention organic practices, and in fact make an effort to distance themselves from the association, due to either the perception that it is inaccessible to consumers, or the intention to continue using agrochemicals. Indeed, the use of no-till practices, associated primarily with ‘conservation agriculture’ but sometimes also with regenerative approaches, is associated with higher use of herbicides to control weeds, which can be deadly to soil microflora.⁵¹⁵

Thirdly, major shifts in land management may not be ecologically viable. While almost 50% of the earth’s land is considered rangeland (including prairie, savannah, shrubland, tundra, and woodland),⁵¹⁶ this land has uses that are not necessarily compatible with animal husbandry, including as wildlife habitat, watersheds that provide freshwater for animal and human use, and for recreational purposes. Not all rangeland is privately owned, and some is publicly managed for the purposes of conservation or resource development, which also limits its potential for use as grazing land. For example, in the US, approximately 30% of land is considered rangeland (770 million acres), and of this, 66% is privately owned.⁵¹⁷ Overall, any claim suggesting that current livestock numbers could be maintained under a regenerative conversion is likely to be misleading given global land constraints (see Box 25).

Finally, calls for regenerative agriculture-led transition tend to obscure considerations about social equity and context specificity. Approaching a food system transition through a ‘regenerative’ lens has been criticized for failing to address issues of race, equity, and land ownership structures.⁵¹⁸ Since regenerative agriculture is centred on farm management practices, large private landowners could potentially continue to benefit from extensive crop and animal production on their land and avoid addressing the colonial legacies of rangeland farming, particularly in North America and Australia. Farmer-celebrity Joel Salatin has been critiqued for promoting regenerative agriculture, while supporting the deregulation of agriculture that benefits already-well-endowed farmers.⁵¹⁹

IS THERE ENOUGH LAND FOR A REGENERATIVE REVOLUTION?

In the US, where the calls for transition to regenerative livestock have been made most frequently, there are approximately 100 million cattle (including dairy cows). The exact land requirements of a single grazing bovine depend on animal genetics, precipitation, soil, and management practices, amongst other factors, but the average animal needs approximately 1-2 acres of productive grazing land per month. For several months each year, much of this rangeland in the US is covered in snow and the plants are dormant, which reduces the number of acres available and requires hay to be cut and used in winter. Pastures need time between grazing periods to recover, which can range from 30 days in peak conditions to 60 days in hot and dry conditions or late in the fall when plant growth slows.⁵²⁰ Therefore the land needs of cattle in the US based on the current population of animals is approximately 800 million acres,^{li} roughly equivalent to the land currently used by cattle in this country, including cropland used to grow feed crops.⁵²¹ While a US-based regenerative conversion for cattle is therefore theoretically possible, it would leave no land available for other domesticated animals. Globally, the FAO estimates that there are approximately 4 billion acres (or 1.7 billion hectares) of cropland in the world, of which, approximately 30% is used to produce animal feed - or 1.3 billion acres (600 million hectares).⁵²² Another 8 billion acres (3.3 billion hectares) of agricultural land is already used for grazing. If there are 1 billion cattle in the world,⁵²³ needing approximately 8 billion acres of grazing area, then there would again be enough rangeland for cattle grazing. But converting all the cropland currently used to grow animal feed to grazing land would still not be enough land to support other domesticated grazing animals, including sheep, goats, horses, and buffalo.

The way that regenerative agriculture has been promoted by corporations, influential media figures, and other prominent backers has also been criticized for perpetuating the white settler-farmer narrative, ignoring the historic and ongoing contributions of BIPOC^{lii} farmers to sustainable agriculture,⁵²⁴ over-emphasizing the commercial/productivity imperatives in land management, and downplaying practices such as agroforestry or more passive management systems used in many traditional Indigenous cultures around the world. For example, in the United States many Native Americans were displaced when grazing permits were distributed to ranchers, leading to the loss of many medicinal plants through overgrazing.⁵²⁵ By not reckoning with these challenges, the solutions sometimes presented under the heading of regenerative agriculture risk repeating the same injustices of colonialism and white supremacy that these agricultural systems were built upon.

WHAT CAN WE CONCLUDE?

In sum, although regenerative approaches are often seen as an antidote to the ‘techno-fixes’ promoted by the livestock industry (see Claim 7), there is a risk that they be adopted as a form of standardized ‘management fix’ – particularly as corporate actors exercise growing influence. Similar discourses suggest that extensive holistic fisheries, or ‘regenerative ocean farming’, is the single solution for sustainable fisheries and the reduction of GHG emissions in this sector.⁵²⁶ These claims satisfy what is clearly a powerful imperative across debates on ‘protein’ and sustainability: finding ways to justify the continuation of high consumption of animal source foods and the status quo for the current beneficiaries of food systems. They also distract from the general promise of a whole range of sustainably managed extensive livestock systems to contribute to various aspects of sustainability.

li This is based on a calculation that the average cow needs 1-2 acres of grazing per month and that an acre of pasture takes 1-2 months to recover (minus the winter months where animals would be fed cut hay from pastureland).

lii BIPOC stands for Black, Indigenous, and People of Colour.

CONCLUSIONS AND RECOMMENDATIONS

FROM MISLEADING
CLAIMS TO MEANINGFUL
REFORM PATHWAYS



It is clear that **the debates taking place around livestock, fish, ‘alternative proteins’, and sustainability are part of an urgently-needed public engagement with the future of our food systems.** Much of this discussion is taking place in good faith, with valid questions, well-evidenced arguments, an acknowledgment of complexities, and an openness to other perspectives. Scientific studies on these topics generally acknowledge the assumptions that may bias the outcomes and limit their generalizability. For example, the EAT-Lancet report, much-criticized for its ‘planetary health diet’ approach, makes clear that “livestock production needs to be considered in specific contexts”.⁵²⁷ Likewise, many organizations and individuals have gone to lengths to stress that their claims concern only specific production segments (e.g. CAFOs, the largest meat and dairy firms). Some actors may employ discursive shortcuts (e.g. ‘protein transition’) while their underlying analysis remains nuanced. For all of those sounding the alarm on the climate crisis, simple messaging is arguably the only option – in a context where the contribution of livestock to climate change is still unknown to many people,⁵²⁸ and in which any shred of uncertainty reinforces climate scepticism and undermines willingness to take action.⁵²⁹ Furthermore, studies have found media coverage of meat and protein to be “heterogeneous”, suggesting that audiences are at least being exposed to different (and often radically diverging) viewpoints.⁵³⁰

Thanks to the efforts of scientists, civil society groups, and many others, **public awareness has grown, and the urgency of action has been impressed upon governments.** In spite of the misleading claims and overhyped solutions that characterize these debates, a number of imperatives have been clearly established, and can guide the way forward. Whether we are most concerned with climate change, biodiversity loss, livelihood risks, food security, or animal welfare, the status quo in animal production systems is simply not an option. It is now beyond doubt that the sustainability challenges we face cannot be met while livestock systems continue to occupy nearly 80% of global farmland. Intensive livestock systems relying on feed crops must be dramatically scaled back. And despite the many misleading claims about nutrition, there is broad consensus on what healthy diets generally look like, i.e. diets based on a diversity of nutrient-rich foods, such as vegetables, fruits, whole grains, and pulses (beans, legumes, nuts and seeds), and also including meat, dairy, eggs and/or fish in some regional contexts.^{531,532,533} It is also clear that a healthy diet along these lines can be a sustainable diet,⁵³⁴ that the way foods are produced is crucial in determining their health and sustainability impacts, and that the precise shape of these diets will vary from region to region.

However, as Section 2 shows, a series of highly problematic and often misleading claims are pervasive in debates around livestock, fish, ‘alternative proteins’, and sustainability. The assertions above are often drowned out by claims that focus our attention elsewhere; they can also be taken out of context and used to justify pathways forward that simply reinforce the existing problems in food systems.

“ *The sustainability challenges we face cannot be met while livestock systems continue to occupy as much as 80% of global farmland* ”

The heterogeneity of the claims on offer does not translate into a balanced and well-informed debate. Claims are simplistic by definition, and some of the shortcuts are especially misleading and selective. The nuance in scientific studies is often hidden lower down or lost entirely in the ensuing media coverage, resulting in misleading takeaways and extrapolations that endure in public debate and policy discussions. In other cases, evidence is circumvented altogether, and claims are based on speculation and hype. A number of claims about livestock, fish, ‘alternative proteins’, and sustainability are widely repeated and accepted as fact, despite being based on uncertain evidence or addressing only certain aspects of the problem. The half-truths of one claim are the (shaky) foundations on which others are built.

Framing the discussion around these claims narrows the lens in five key ways, leading to simplistic silver bullet solutions:

1. OVEREMPHASIS ON PROTEIN

For decades, the perceived need for more protein has led to distractions and distortions in development programs, flawed marketing and nutritional campaigns, and calls to increase the production and trade of meat, dairy, and protein-enriched foods (Claim 1). Today, the evidence clearly shows that there is no global ‘protein gap’: protein is only one of many nutrients missing in the diets of those suffering from hunger and malnutrition, and insufficiency of these diets is primarily a result of poverty and access. However, debates remain protein-centric, with the focus now on producing enough protein to feed the world in the face of supply constraints and rising demand (Claims 1, 4,

5, 6). In this context, animals are consistently reduced to meat, and meat is reduced to protein. Meat, dairy, eggs, fish, and a range of substitute products are increasingly lumped together under the heading of 'protein', masking the major differences between these sectors. The 'protein obsession' is now shaping the political agenda and setting the parameters for scientific studies, media coverage and public debate, with farming systems assessed primarily (or solely) in terms of protein production per unit of GHG emissions. The idea that a 'protein transition' is needed frames almost all of the discussion on pathways for addressing animal source foods and reforming food systems (Claims 5-8). This fuels ongoing calls to increase and intensify the production of various high-protein foods, with less attention to *how* foods are produced.

“ A ‘protein obsession’
is now shaping the political
agenda & setting the parameters
for scientific studies, media
coverage & public debate ”

2. REDUCING SUSTAINABILITY TO GHGS ONLY

Reducing GHG emissions from livestock is an urgent challenge. However, climate change mitigation is regularly separated from other critical and interconnected sustainability challenges, including biodiversity loss, chemical pollution, land degradation, livelihood stresses, hunger, and micronutrient deficiencies. In the search for solutions, the problems to be solved are often collapsed into a single dimension – GHG emissions, and sometimes just CO₂ or methane. GHG-centric approaches are particularly visible in claims about the relative benefits of 'alternative proteins' (Claim 5) and the potential of regenerative livestock systems or 'carbon farming' (Claim 8), as well as in the focus on methane digesters and other 'techno-fixes' for livestock facilities – and a concomitant lack of focus on feed crops and their multiple environmental and social impacts (see Claim 7). Furthermore, livestock challenges are increasingly being approached under the overarching goal of turning land into a 'net carbon sink' and assessed in terms of 'carbon opportunity costs'. By positioning livestock as a barrier to net zero in the land sector, some simplistic claims end up treating all livestock like an extractive industry and ignoring the diversity of production systems and their impacts (positive and negative) on other aspects of sustainability. Although GHGs are less dominant in discussions on fish, similar patterns emerge, with sustainability concerns expressed in general terms

(Claim 3), and the huge differences between aquaculture systems regularly overlooked (Claim 6). Blunt approaches focused on single dimensions of sustainability are clearly ill-adapted to capture the full impacts and interactions of complex socio-ecological systems like livestock and fisheries. Solutions that follow from a narrow GHG focus are unlikely to actually address climate change, let alone the other sustainability challenges in food systems.

“ Solutions that follow
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in food systems ”

3. FAILURE TO CONSIDER HOW FOODS ARE PRODUCED

The over-emphasis on narrow metrics like protein/GHGs is compounded by a recurrent failure to account for different types of animal production systems. Industrial feedlots generate impacts of a different nature and magnitude to other livestock systems, as a result of requiring vast amounts of land and resources for feed crop production, and generating specific health risks (e.g. AMR, air pollution, groundwater contamination) via concentrated waste flows. The positive contributions livestock can make to food security and sustainability also differ enormously between different types of systems. In many farming communities, animals play multiple roles: they provide food, hides, wool, and traction, help fertilize soils, act as financial collateral, hold cultural value, and make use of marginal land in a way that brings livelihoods, income, and food security to regions with few alternatives (see Claims 3 & 4). Huge differences also exist between different models of aquaculture and how they interact with ecosystems and communities, as well as between aquaculture and wild fisheries systems. Yet these barely comparable systems are regularly conflated, with very little discussion of agro-silvo-pastoral systems, multi-paddock grazing, pastoralist systems, integrated multi-trophic aquaculture systems, artisanal fisheries, and the wealth of integrated and often small-scale systems that fall broadly under the heading of 'agroecology' (see Claims 2, 3 & 6). Studies purportedly showing the benefits of 'alternative proteins' are often narrow comparisons against a single (conventional) livestock system on GHG

terms (Claim 5). Even when claims appear to point in different directions – ‘livestock is unsustainable’ (Claim 3) vs. ‘livestock can be made sustainable with techno-fixes’ (Claim 7) – they converge in treating livestock as a single (industrial) system. Similarly, plant-based diets are often presented as a singular, standardized option that can be universally adopted in place of meat-based diets, despite the huge differences in environmental and social impacts depending on how plant ingredients are grown and processed.

“ *Claims that we need more protein but less meat are out of sync with the realities of food insecurity in many parts of the Global South* ”

4. FAILURE TO DIFFERENTIATE BETWEEN WORLD REGIONS

Another problem with claims about livestock, fish, ‘alternative proteins’ and sustainability is the recurrent failure to specify *where* and *for whom* these claims apply. A number of claims are problematic because they ignore context-specific realities. The value of meat as a source of high-quality bioavailable protein and diverse micronutrients for many populations around the world tends to be overlooked, or considered as a secondary question (see Claims 2 & 3). Pastoralist systems and small-scale artisanal fisheries, still so prevalent in many developing countries and so critical for livelihoods, also tend to be ignored in the universalizing discourse of a ‘protein transition’. A number of solutions that are purportedly universal have clearly been envisaged through a Global North lens. Claims around regenerative livestock (see Claim 8) have arisen from a select number of contexts and spilled over into global discussions. ‘Alternative proteins’ (see Claim 5) are another example of a ‘universal solution’ being rolled out globally, while clearly designed for a Global North context (i.e. characterized by overproduction and overconsumption of animal source foods, high incomes, general access to diverse food sources, etc.). The collective wisdom conveyed by Claims 1, 2, 3, and 5 – that we need *more protein* but *less meat* – is out of sync with the realities of food insecurity and livelihood challenges in many parts of the world, particularly in the

Global South. In some cases, the problem is a failure to explain to whom recommendations are really being addressed. For example, the columnist George Monbiot has explained that *Seaspiracy’s* message – that people should stop eating fish – was intended for “people with a Netflix subscription”.⁵³⁵ Context matters greatly where animal source foods are concerned and is often lost in current debates.

5. FAILURE TO CONSIDER COMPLEXITIES, PATH DEPENDENCIES, AND POWER DYNAMICS (FAILURE TO SEE THE WHOLE FOOD SYSTEM)

The latest ‘techno-fixes’ for livestock and aquaculture (e.g. novel breeding techniques, vaccines, new housing units) are generally designed for industrial settings and are based on further increasing their intensity, uniformity, and density (see Claims 6 & 7). These innovation pathways are therefore likely to generate further problems down the line, requiring another round of technological innovations in order to preserve productivity gains. ‘Management fixes’ can also be short-sighted: claims about the potential of regenerative livestock systems – particularly those made by the food industry – tend to ignore questions like equitable land distribution, participation, and social and racial justice (see Claim 8). Furthermore, these solutions rely on vast swathes of land being spared/rewilded (Claims 5 and 7) or turned to extensive grazing (Claim 8) – none of which can be taken for granted.^{liii} Claims about ‘alternative proteins’ also tend to ignore the risks of reinforcing current food system dynamics, such as the reliance of these new technologies on mass-produced, monocultured ingredients and energy-intensive hyper-processing – which will offset many of the benefits of taking factory farms off stream (see Claim 5). Lab-grown meat is particularly energy-intensive, and its potential to deliver GHG savings depends on the decarbonization of energy systems. As manufacturers seek to make these technologies cost-competitive, more corners are likely to be cut. Furthermore, the potential of the various corporate-led solutions to have a positive impact on sustainability, livelihoods, and resilience is severely constrained by the business model of a highly concentrated industrial agri-food sector, which systematically relies on abusive practices and generates hidden costs or ‘externalities’ (as described in Claims 6 & 7). While start-ups have initiated the alternative protein boom, the sector is increasingly characterized by giant protein companies who are combining industrial animal-based products with industrial analogues. In other words, these solutions require major shifts in land use, energy systems, economic incentives, and corporate practices in order to deliver benefits. But these same solutions

liii One recent study acknowledges major gaps in data and understanding regarding land use change: “Further detail and standardization in land-use emissions and sequestrations is required in the future, including an appraisal of likely alternative land-uses following sparing of current agricultural land.” In Lynch and Pierrehumbert. “Climate impacts of cultured meat and beef cattle.”

reinforce the power relations that keep current systems in place, and fail to address the question of how systemic changes will be achieved.^{liv}

Critically, the effect of framing the debate so narrowly is to focus our attention on simplistic solutions. Through the lens of protein on one side and GHG emissions on the other, sectors and activities that are barely comparable are set alongside each other, using metrics that are ill-adapted to capture the functions, interactions, and impacts of many livestock and fishery systems. Questions of *how* and *where* food is produced are lost in the hype around silver bullet solutions. And when challenges are formulated in such a reductive way, lab-grown meat and novel plant-based substitutes appear to be the most viable solutions. ‘Techno-fixes’ for industrial feedlots are similarly well-placed to answer such narrowly defined needs. A superficial industry-led vision of regenerative livestock management is also gaining traction. And when simple solutions cannot be squared with the complexities of land-based food production, scaling up aquaculture is identified as the way to do *more with less*.

Furthermore, **the misleading claims that dominate meat and protein debates prevent consideration of more transformative pathways.** The focus on breakthrough technologies to fix animal production systems and/or accelerate a ‘protein transition’ diverts our attention away from viable, ecologically-based alternatives, as well as social innovations that allow for potentially more immediate, significant, and safer sustainability gains. Furthermore, the focus on *consumers* – as drivers of rising meat demand, as potential adopters of new proteins – obscures the ongoing role of the agri-food industry in shaping what we eat (see Claim 4), and downplays the potential for bigger dietary changes. As a result, insufficient attention is paid to transformation pathways based on a paradigm shift towards diversified agroecological production systems, territorial food chains and markets, and ‘food environments’ which increase access to healthy and sustainable diets. These pathways respond holistically to challenges whose breadth and depth have been well-evidenced. They entail transformative behavioural and structural shifts; they require *sustainable food systems transitions*, not merely a *protein transition*. Yet without a consolidated set of claims and claim-makers behind them, these pathways are systematically sidelined.

The challenges are arguably becoming greater as ‘protein’ is sucked ever-further into the vortex of hype that characterizes online discussion spaces. Meat and protein are now being debated in a context in which TED Talks and Netflix documentaries can rapidly accrue millions of views; in which the shareability and clickbait potential of ‘news’ often trumps content; in which successful hyping of a breakthrough technology can spark rapid market capitalization; in which meat is being rebranded as ‘protein’ and plant-based products redefined as ‘meat’;^{lv} in which the passing opinions of philanthro-capitalists are broadcasted on a vast range of topics; in which global consultancies are commissioned to ‘align’ troublesome sectors with the SDGs and map out the development pathways of nation states; and in which **making big claims about protein and sustainability is clearly big business.**

“*Lab-grown meat is energy-intensive & its potential to deliver GHG savings will depend on the decarbonization of energy systems*”

In this environment, complex pathways of systemic change struggle to be heard. Instead, actors revert to their specific problem framings and preferred lexicons, and the discussion is reduced to a simplistic head-to-head – meat vs. plant-based diets, meat vs. ‘alternative proteins’, industrial vs. regenerative, animal farming vs. fish farming, aquaculture vs. wild fisheries – in which protein/CO₂ is the dominant metric.

Reframing and resetting the debate around livestock, fish, ‘alternative proteins’, and sustainability is essential at this critical juncture for food systems reform and climate action. The claims being advanced in this area are already shaping the actions of investors, corporations, farmers, and consumers. Although policy frameworks are still nascent, lobbying is intensifying around a range of solutions.

^{liv} In some cases, claims about ‘protein transition’ have at least come alongside recognition of the need for policy reform and systemic change. For example, the authors of a 2021 study suggesting a “double climate dividend” from eliminating meat consumption have highlighted the need to link land, food, public health, and climate policy in order to deliver these benefits.

^{lv} In Briggs, Helen. “Veg diet plus re-wilding gives ‘double climate dividend.’” *BBC*. January 10, 2022. <https://www.bbc.com/news/science-environment-59941016>
^{lv} The ‘Redefine Meat’ firm has made this reconstruction of meaning an explicit goal.

GOVERNMENT SUPPORT FOR 'ALTERNATIVE PROTEINS'

- **China.** China's latest Five-Year Agricultural Plan (January 2022) identified cultivated meat as a focus area of innovation for the first time, suggesting that major funding could be dedicated to the sector over the coming years – building on recent publicly-funded research grants for 'alternative proteins' (under the heading of "biological manufacturing").⁵³⁶
- **US.** The USDA is injecting \$10 million into a National Institute for Cellular Agriculture.⁵³⁷
- **Germany.** In 2021, the new German coalition government announced a strategy to shift towards sustainable food systems, including plans to support plant-based 'alternative proteins', incentives to switch to organic farming, and the introduction of a compulsory animal welfare label.⁵³⁸ In 2022, construction will also start on a €200 million (\$219 million) 'food campus' in Berlin, with 15,000 m² of production and research space for sustainable food innovators, including cultivated meat firms.
- **Denmark.** A 2021 Danish multi-party agreement on green transformation included a 675 million kroner (\$98 million) Fund for Plant-based Food Products, alongside a 260 million kroner (\$38 million) 'green proteins' strategy that will fund, inter alia, fermentation-based proteins and lab-grown meat.⁵³⁹
- **EU.** Increasing the "availability and source of alternative proteins such as plant, microbial, marine and insect-based proteins and meat substitutes", is a priority in the EU's 'Horizon Europe' research and innovation package, and has been reiterated by the European Commission as a goal of the Farm to Fork Strategy.⁵⁴⁰

Public investment in plant-based substitutes and lab-grown meat is rapidly accelerating, sometimes in the remit of ambitious (plant) protein strategies (See Box 26). In other cases, for example in France^{lvi} and Canada,^{lvii} policy packages are being rolled out with a strong focus on increasing domestic protein feed for livestock, alongside some measures to increase human consumption of pulses. In addition to the growing focus on 'regenerative' agriculture, governments and corporations are also throwing their weight behind 'carbon farming' – with the European Commission highlighting its value as "a new source of income for land managers".⁵⁴¹ Regulatory change is also afoot, with Singapore commercially licensing lab-grown meat and others likely to follow, and pressure on regulators to approve new breeding technologies.⁵⁴²

As new policy frameworks emerge, and meat and protein continue to rise up the agenda, it remains critical to move beyond misleading claims. If not, there is a risk that general inaction is replaced with misguided action; that precious opportunities to reinvest in food systems are wasted on pathways that are disruptive but not transformative; that public good is confused with private good.

The following recommendations are focused on reframing the discussion, overcoming polarization, and putting the conditions and frameworks in place for truly transformative reform pathways to emerge:

lvi In 2020, France announced a plant protein strategy worth €100 million (\$109 million) to boost domestic plant protein production, aiming to "win back protein sovereignty" with additional funding allocations under the 2021 COVID recovery package ('Plan Relance'). The strategy aims to reduce dependence on imported protein feed, increase the feed autonomy of livestock farms, and develop the local provisioning of pulses.

In Ministère de l'agriculture et de l'alimentation. "France Relance : le plan protéines végétales accélère son déploiement avec 26 nouveaux projets soutenus sur tout le territoire." June 30, 2021. <https://agriculture.gouv.fr/france-reliance-le-plan-proteines-vegetales-accelere-son-deploiement-avec-26-nouveaux-projets-sur>

lvii In Canada, a public-private partnership called 'superclusters' has established Protein Industries Canada on the Canadian Prairies. This project aims to grow plant-based proteins by improving nutrition through plant genetics and investing in novel processing technologies and digital solutions.

In Government of Canada. "Innovation Superclusters Initiative." Oct 29, 2021. <https://www.ic.gc.ca/eic/site/093.nsf/eng/home>

RECOMMENDATION 1.

SHIFT THE FOCUS FROM 'PROTEIN TRANSITION' TO SUSTAINABLE FOOD SYSTEM TRANSITION AND SUSTAINABLE FOOD POLICIES

Making a 'protein transition' a global imperative and stand-alone policy goal risks penalizing all livestock systems. It may also lead to the promotion of 'alternative proteins' irrespective of the risks and uncertainties they entail. Nor is it guaranteed that stand-alone protein strategies will actually lead to reductions in total meat and dairy consumption – a concern that has been raised about the recently-launched policy frameworks in France⁵⁴³ and Denmark⁵⁴⁴.

However, in some contexts – particularly in Global North regions with excessive production and consumption of animal source foods – 'animal source food transitions' or 'less and better meat/dairy' can be useful sub-objectives within a comprehensive sustainable food policy. This can allow sequenced shifts in production/consumption of animal source foods to be balanced against and informed by other priorities (e.g. GHG emission reductions, territorial cohesion, defending local food cultures) and advanced in relation to overarching objectives (e.g. food and nutrition security, healthy diets, fair and resilient supply chains, sustainable livelihoods).

Comprehensive food policies, underwritten by cross-sectoral participation and decision-making, can pull simultaneously on various levers of change, shifting the multiple incentives that are locking industrial food systems in place, and reinforcing high/excess consumption of animal source foods in many countries (see discussion of Claim 4).

Transformative reform pathways that can reconcile these different priorities are more likely to receive the attention they deserve in the remit of a comprehensive food policy than in sectoral policies (agriculture, trade, etc.) or narrowly-focused 'protein' strategies. Indeed, any policy with serious ambitions to improve diets will need to look towards comprehensive 'food environment' approaches^{lviii} that connect social policies with food production and supply chain policies, ensuring that as the incentives shift and food prices potentially change, low income populations maintain access to nutritious diets, including animal source foods. Furthermore, livestock and fisheries reform pathways can be considered connectedly under the umbrella of a food policy, with a view to ensuring access to protein and micronutrients for all. The power of food policies to address food system challenges in a joined-up way is being demonstrated by local authorities around the world, as well as emerging examples at regional and national level (see Box 27).

BOX 27

ADDRESSING ANIMAL SOURCE FOODS THROUGH COMPREHENSIVE FOOD STRATEGIES: LONG-STANDING POLICIES, EMERGING FRAMEWORKS, AND ASPIRATIONAL VISIONS

- The EU Farm to Fork Strategy, announced by the European Commission in 2020 as part of the European Green Deal, includes a cross-cutting 'Farm to Fork Strategy' that aims to make food systems fair, healthy and environmentally-friendly. The Strategy includes plans to address the over-consumption of meat and increase access to plant-based foods using tax incentives.⁵⁴⁵ Although the Farm to Fork strategy has been endorsed by MEPs and civil society groups, it does not address the full range of policy levers and does not yet constitute the holistic vision put forward by IPES-Food in its calls for a 'Common Food Policy'.⁵⁴⁶ IPES-Food's proposals – co-developed with 400 stakeholders over a 3-year deliberative process – included calls for national healthy diet plans to build better food environments, as well as eliminating direct CAP payments per head of cattle, and shifting subsidies towards agroecological transition.
- In the 1970s, the Finnish region of North Karelia was part of a longitudinal study on the relationship between lifestyle, diet, coronary heart disease and stroke called the Seven Countries Study.^{lix} Working with local people to increase local life expectancy through a comprehensive public health strategy, the project increased local berry consumption, encouraged processors to reduce salt and animal fat in locally-consumed products, recommended the use of locally-produced canola oil as an alternative to butter, and supported local smallholders to develop low-fat milk products.

lviii The EU Farm to Fork Strategy acknowledges the importance of joined-up, systemic approaches to dietary change, stating that "The creation of a favourable food environment that makes it easier to choose healthy and sustainable diets will benefit consumers' health and quality of life, and reduce health-related costs for society." In European Commission, *Farm to Fork Strategy*.

lix This study found a link between blood cholesterol levels and hypertension and coronary heart disease. However, critiques of this study are extensive, including the selection of seven countries of the possible 22 and the exclusion of sugar and refined carbohydrates from the analysis. In Pett et al., "Ancel Keys and the Seven Countries Study."

There were also complementary measures to reduce smoking rates. Several of these measures were introduced by throwing ‘longevity parties’ in collaboration with women’s organizations where recipes that suggested variations on local specialities were introduced. Community participation was a key tenet of this program. The death rate from coronary disease dropped 73% in middle-aged men over 25 years.⁵⁴⁷ Although the interactions among all risk factors and health outcomes are still poorly understood, the case illustrates that behaviours and health outcomes can be shifted.

- Since the late 1990s, a traditional **Korean** menu has been served at the country’s schools, comprising fruits and vegetables, kimchi, and lean meats with a variety of grains and legumes – and moderate use of salt, oils, and fats. A 2010 survey found that 50% of South Korean adults followed this traditional diet, 40% followed a Mediterranean-style diet, and only 10% indulged in a ‘Western’ diet – down from 35% in 1998.⁵⁴⁸ This program, driven by public bodies and NGOs, was found to be a factor in curbing the obesity epidemic in South Korea. It’s not just that the diet was healthy – which was an important message – but that it was a traditional Korean diet that also resonated with the population.
- In **Denmark**, a 2021 multi-party agreement on the green transformation of agriculture aimed to lower emissions, reduce nitrogen use, and improve ecological systems. Alongside the investments in ‘alternative proteins’ mentioned above, the strategy’s Fund for Plant-based Food Products – involving 675 million kroner (\$99 million) from 2022-2030 – will support crop variety development, cultivation, processing, promotion, export promotion, training and knowledge dissemination. The goal is to dedicate at least half of the funding to plant-based organic food, with farmers receiving bonuses for producing plant-based protein crops for human consumption.⁵⁴⁹ Nonetheless, the investments may be tied to big export industries, while parallel actions to curb meat consumption/production appear to be absent.⁵⁵⁰
- Acknowledging the role of diets in climate mitigation, **Ghent** was the first city in Belgium to launch a local action plan to shift protein consumption as part of its broader municipal food policy. Leveraging the power of public procurement, every Thursday, Ghent’s schools, day-care centres and public services serve vegetarian meals as part of the ‘Thursday Veggie Day’ campaign the city launched in 2009. The city also promotes restaurants and shops that offer vegetarian alternatives, coaches restaurants in preparing vegetarian meals, works with local businesses to organise vegetarian cooking workshops for residents, as well as working with local producers and consumers to increase access to a diversity of sustainable local animal and plant protein.⁵⁵¹ To help meet its food policy objective of ensuring that all its residents can eat sustainably, Ghent is now also targeting a shift from current protein consumption trends – 60% animal source and 40% plant-based – to 60% plant-based and 40% animal source by 2030, as part of the Flemish region’s ‘Green Deal Protein Shift’.⁵⁵²
- In 2010, the Swedish city of **Malmö** developed a 10-year plan for food and sustainable development. Its primary objectives were to achieve 100% organic procurement by 2020 and reduce the City’s food-related GHG emissions by 40% compared to 1990 levels.⁵⁵³ To get there, Malmö’s Environmental Department developed a strategy including awareness programs on how food and climate are connected, school meal reforms (minimizing empty calories, serving high-quality meat and vegetables, reducing waste), cooking classes for school canteen chefs and residents, alongside steps to improve transport efficiency (distance, vehicle, packing efficiency, fuel choice). Ten years on, schools now primarily offer organic plant-based meals, and serve sustainably sourced meat or fish 2-3 days per week (compared to serving animal source foods every day in 2010). Combined with efforts to procure locally, efficiently, and to reduce waste where possible, Malmö reduced its quantifiable food-related emissions by 30% between 2010 and 2020 – making it one of Sweden’s lowest-emitting municipalities.⁵⁵⁴

FIGURE 12

MOVING FROM PROTEIN HYPE TO SUSTAINABLE FOOD SYSTEMS

CONCLUSIONS

There's lots of hype
about meat and protein

It's narrowly
focused on CO₂

It ignores
how food is produced

It ignores
differences between
world regions

It fails to see the
whole food system

It's focused on
simplistic silver
bullet solutions

RECOMMENDATIONS

1

Focus on achieving a
transformation to
'sustainable food systems' -
not a 'protein transition'

2

Prioritize reforms that deliver
on **all aspects of sustainability**
starting at regional level

3

Reclaim public resources
from 'big protein',
realign innovation pathways
with the public good,
and reset the debate



RECOMMENDATION 2. PRIORITIZE REFORM PATHWAYS THAT DELIVER ON ALL ASPECTS OF SUSTAINABILITY, STARTING AT THE TERRITORIAL LEVEL (MEASURE WHAT MATTERS, WHERE IT MATTERS)

A whole range of social and environmental criteria must be taken into account, alongside GHG emissions, in order to comprehensively assess the sustainability of livestock and fishery systems – including impacts on biodiversity, resource efficiency, circularity, resilience, sustainable livelihoods, local nutrient availability and food security, territorial cohesion, and food cultures. The UN Sustainable Development Goals (SDGs) are a useful compass in this regard, requiring countries to reconcile wide-ranging social, economic, and environmental indicators and thereby requiring multifunctional approaches in key sectors like agriculture.

“ *The region/territory
is a key level for developing
comprehensive food
policies and strategies* ”

Furthermore, it is crucial to consider how animal production systems compare to realistic alternative land uses and economic activities, in a context where people need access to nutritious foods. The region/territory is therefore a key level for developing the comprehensive food policies and strategies described in Recommendation 1 – potentially layered into national food policies with multi-level governance approaches. Criteria like resource efficiency and circularity have meaning in their local and regional contexts, and are more likely to be prioritized in regionally-defined food strategies. Focusing on the regional/territorial scale will also help to unleash the benefits that many regions can derive from relocalizing livestock production, reintegrating it with landscapes and feed sources, and reusing waste locally/on-farm, while ensuring scale-appropriate trade flows. In other regions, bigger dietary shifts, and a greater role for international trade, are likely to be necessary to meet those same objectives and reconcile the different aspects

of sustainability. Weighing the different priorities against each other will remain complex in any scenario. But doing so at the relevant scales allows us to move beyond abstract and generalized assumptions about global land use efficiencies.

‘Territorial markets’ offer another useful and scale-appropriate framework for sustainable livestock transition, although there is considerable variation in the types of supply chain referred to under this umbrella – and a number of important questions to address about how territorial markets can support agroecological production. Although still embryonic, ‘territorial diets’ offer another framework to guide discussion around shifting the production/consumption of animal source foods. Focusing on territorial diets could be complementary to national dietary guidelines, allowing their (inevitably) generalized guidance to be broken down and allowing healthy and sustainable diets to be defined in more culturally-specific ways.^{lx}

RECOMMENDATION 3. RECLAIM PUBLIC RESOURCES FROM ‘BIG PROTEIN’, REALIGN INNOVATION PATHWAYS WITH THE PUBLIC GOOD, AND RESET THE DEBATE

In previous reports, IPES-Food has sounded the alarm on rampant consolidation across all nodes of the agri-food chain, identifying concentration of power as *the* central factor locking in industrial food system dynamics.⁵⁵⁵ Power imbalances clearly help to create an environment in which misleading claims are rife and a handful of actors can set the agenda. Addressing concentration of power is all the more urgent in the ‘protein’ sector, where horizontal integration and huge capital influxes are rapidly reshaping the terrain and influencing public discourse. Public endorsement and financial backing for ‘alternative proteins’ will be increasingly solicited in the coming years, with manufacturers promising to deliver benefits for the ‘public good’.⁵⁵⁶ Fixes for intensive livestock and fish production will also continue to make claims on public resources (e.g. via government subsidies in Global North countries, and agri-development initiatives focused on the Global South).

A number of actions are required in order to redistribute power and redress the balance. Firstly, a clear set of parameters is needed to assess technologies and

lx One of the most well-known territorial diets is the Mediterranean Diet. In 2010, UNESCO recognized the Mediterranean Diet for the cultural value embodied in the “skills, knowledge, practices and traditions from landscape to table, including crops, harvesting, fishing, conservation, processing, preparation, and, in particular, food consumption.” However, the loss of intergenerational knowledge transfer from living in extended family settings to more nuclear family settings has shifted diets away from traditional consumption patterns in more recent years.

In Hachem et al., “Territorial and Sustainable Healthy Diets.”

realign innovation pathways with the public good. The precautionary principle must be re-established, with consideration of whether innovations will deliver social/equity gains; whether they will further centralize or decentralize power in food systems; whether they will advance the decarbonization of food systems or introduce new fossil energy dependencies, etc. Such criteria are unlikely to be met by channelling public funds into 'alternative proteins': doing so risks giving protein firms greater power to set the terms of debate, and further distorting innovation incentives in favour of so-called 'disruptive' technologies. Indeed, decision-makers should pay attention to the long-term effects on food systems and innovation systems in the broadest sense, and the implications in terms of reinforcing concentrations of power. Where lab-grown meat is concerned, the risks and benefits of a broader shift towards soilless (and largely farmer-less) production in controlled environments should be taken into account. GMOs offer a cautionary tale in terms of how the agenda can be shifted by unleashing new dynamics and actors into food systems, to the detriment of agroecological approaches and innovation systems. Holding up innovations against public good criteria will help to puncture the bubble of hype around some technologies, while helping to steer others towards genuinely transformative pathways.

Secondly, actions are required to address concentration of power across the food system. A number of actions have been put forward by IPES-Food to tackle monopolies, including through new approaches to antitrust and competition law (see Box 28). In light of the 'protein convergence', actions targeted at shifting the practices of a limited number of leading firms could have major ripple effects. Promoting organizational diversity and supporting start-ups to stay independent could also be key steps, as part of broader strategies to counter corporate concentration.

Further actions are required to strengthen alternative supply chain infrastructures (e.g. territorial markets that link to small-scale agroecological production, cooperatively-owned grocery stores, Community Supported Agriculture schemes, farmers' markets), as well as ensuring that food safety rules do not impose undue burdens on smaller-scale operations, and providing advisory services and infrastructure support for agroecological food systems (e.g. farm equipment to support polyculture production). It is only once these options emerge further into the mainstream, creating widely-available alternatives between hyper-local and transnational supermarket-led food provisioning, that power relations will shift – and with them, new ways of framing these questions that go beyond industrial meat versus industrial substitutes.

Finally, debates on meat and protein must be reclaimed from powerful actors and interests, and rebuilt on the understandings and perspectives of diverse actors, including groups whose voices are rarely heard (e.g. pastoralists, herders, artisanal fishers, Indigenous peoples, food insecure groups, practitioners).⁵⁵⁷ This means reinvesting in deliberative democratic processes and consultative decision-making spaces, and resisting attempts to fast-track agreement around seemingly consensual 'solutions' in 'multistakeholder' arenas like the 2021 UN Food Systems Summit.⁵⁵⁸ It also means entering into genuine conversations where uncertainties are recognized, normative biases are acknowledged, and opposing views are confronted and potentially reconciled (e.g. that meat is an important part of food cultures *and* that food cultures evolve rapidly; that meat can provide nutritionally essential intake of protein and micronutrients *and* that diverse plant-based diets can also provide those benefits; that animal farming is inherently cruel in the eyes of some *and* that others feel culturally attached to farming animals and eating meat). People may not agree on the relative importance and implications of these different assertions, but they should be able to agree on their validity and relevance.

*“ Actions are required
to address concentration
of power across the
food system ”*

Polarization – between animal welfare activists and livestock farmers, between environmental and anti-poverty groups, between urban and rural populations – benefits powerful food system actors, allowing their claims and top-down solutions to set the agenda, even as they exclude a number of crucial perspectives. In a range of contexts and at different scales, valuable new spaces are being developed to overcome polarization and facilitate democratic debates on the future of food systems. Only by deepening these efforts and overcoming polarization can misleading claims, false solutions, and the vested interests behind them be definitively called out, and transformative change pathways be set in motion.

CONCENTRATION OF POWER IN FOOD SYSTEMS AND HOW TO TACKLE IT

In its 2017 report, *Too Big to Feed*,⁵⁵⁹ IPES-Food took stock of concentration throughout the agri-food sector. The report found that a significant horizontal and vertical restructuring is underway across food systems. Rampant vertical integration is allowing companies to bring satellite data services, input provision, farm machinery and market information under one roof, transforming agriculture in the process. The rush to control plant genomics, chemical research, farm machinery and consumer information via Big Data is driving mega-mergers. IPES-Food found that consolidation across the agri-food industry has made farmers increasingly reliant on a handful of suppliers and buyers, further squeezing their incomes and eroding their autonomy. Further, the scope of research and innovation has narrowed as dominant firms have bought out the innovators and shifted resources to more defensive modes of investment. Increasing market concentration has reinforced a focus on input traits and major crops promising greater returns on investment. Noting the narrow focus of existing antitrust regimes on 'consumer welfare', and the general failure to consider the impact of industry consolidation on farmers, on governance (e.g. increased lobbying power), and its broader implications for sustainability, IPES-Food recommended a number of steps to curb consolidation and support alternative food system models:

- Create a **new antitrust environment** by building on steps being taken in a variety of jurisdictions and sectors to crack down on unfair trading practices in supply chains, to reframe the scope of antitrust rules (e.g. by lowering the threshold of what constitutes a 'dominant market share'), and to address cross-cutting incentives and drivers of consolidation (e.g. data-driven concentration, 'tax inversions');
- Develop a collaborative assessment of agri-food consolidation and a **UN Treaty on Competition** to deliver transnational oversight of mega-mergers;
- Shift towards diversified and decentralized innovation, locally-applicable knowledge and open access technologies – a new '**wide tech**' paradigm' – to harness the benefits of Big Data for all;
- Promote **short supply chains, innovative distribution, and exchange models** – such as 'solidarity economy' initiatives – in order to circumvent, disrupt, and de-consolidate mainstream supply chains, steps that must ultimately be supported and brought together under integrated food policies.

To conclude, livestock, fish, and 'alternative proteins' will stay in the spotlight for many years to come, as sustainability challenges mount and visions for the future of food systems collide. This report and these recommendations conclude one phase of reflection, but they are part of a broader process that continues onward. Over the coming months, the report's findings will be tested, built out, and further refined in their regional contexts, through a number of follow-up activities.

Indeed, the claims described in this report are only a handful of the many ways in which actors are framing the debate around meat and protein. The solutions put forward and the claims used to advance them will vary between regions and evolve over time. The analysis and the recommendations outlined above are tools that can be used to make sense of claims as they evolve. Underpinning all of these recommendations is the need to widen our lenses and open the door to truly transformative reform pathways.

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ABOUT IPES-FOOD

The International Panel of Experts on Sustainable Food Systems (IPES-Food) seeks to inform debates on food systems reform through policy-oriented research and direct engagement with policy processes around the world. The expert panel brings together environmental scientists, development economists, nutritionists, agronomists, and sociologists, as well as experienced practitioners from civil society and social movements. The panel is co-chaired by Olivier De Schutter, UN Special Rapporteur on extreme poverty and human rights, and Maryam Rahmanian, independent expert on agriculture and food systems.

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