Outcome Paper for Discussion

SCIENCE TO SOLUTIONS DIALOGUE 2
People, Planet, Protein - What's the Plan?

EAT and the World Business Council for Sustainable Development (WBCSD) through FReSH (Food Reform for Sustainability and Health) convened a series of Science to Solutions Dialogues (SSDs). This second Dialogue brought together business scientists, academic scientists and civil society to discuss two challenges within the food system: how to inspire consumers to shift to more sustainable and healthful protein sources; and how to ensure a shift to more sustainable livestock production systems. The following paper sets out the emerging solution spaces in order for business to provoke discussion and feedback.

Food systems – all the processes involved in feeding the global population – are key to supporting good health and well-being and are a critical part of the biosphere underpinning prosperous societies and economies.[1] Decisions on how we produce food and what food we produce have significant impacts on the environment. Evidence suggests that food systems are providing neither for people nor for the planet. Despite progress on improving nutrition, the burden of malnutrition remains stubbornly high: 815 million individuals are hungry,[2] 2 billion are deficient in critical micronutrients[3] and 2.1 billion adults are overweight or obese,[4] contributing to the upsurge in diet-related diseases.

Beyond nutritional outcomes, food systems are also a main contributor to environmental damage, responsible for 19-29% of greenhouse gas (GHG) emissions[5] and agriculture being responsible for 70% of global freshwater use,[6,7] and driving deforestation, biodiversity loss, land degradation and pollution. This does not need to be so.

Key takeaways

- FReSH plays a central role in championing a new narrative, one that advocates for healthy diets including the right amount and quality of protein that supports optimal human health, produced sustainably within planetary boundaries.
- It's necessary to shift the public debate to focus on quality (health+environment+social) in addition to quantity.
- Action is needed urgently within a two-year timeframe to set us on a transformational path.
- Create a harmonized framework that captures the true value of food: the positive and negative externalities.
- To be transformational, action will need to be universal and mainstreamed.
- A strong business case is needed to demonstrate the full health *and* environmental *and* social *and* business benefits of a more balanced animal- and plant-based protein consumption and production.
- Yet a business case will only advance action so far: science, policy-makers, the technology sector and civil society need to provide support to develop solutions, implement supportive policy, develop new technological solutions and engage with consumer groups to increase trust.
- Multistakeholder and multisector collaboration needs to be normalized to achieve food system transformation.
- The dialogue did not reach a full consensus as yet on:
  - Nudging people to consume smaller portions of red meat and other animal protein, and to do so less frequently, and to consume healthier and more sustainable sources of protein, especially plant protein.
  - Pushing producers toward sustainable livestock production without making sure all economic and environmental trade-offs are fully understood.
- FReSH will continue the dialogue to seek consenses and solutions.

A role for business

Businesses are a crucial element of food systems as nearly all food consumed around the world is produced, processed or supplied by them: be it large agribusinesses, smallholders, or small and medium enterprises. This puts large and small businesses at the heart of the potential for food system transformations. FReSH, which emerged from the EAT and WBCSD partnership, provides a platform for businesses to proactively develop business solutions where they can have the most impact on reversing health, environmental and social issues stemming from food systems.

We will not achieve the Sustainable Development Goals (SDGs) or the Paris Climate Change Agreement without fixing food systems, and this requires the proactive engagement of business.

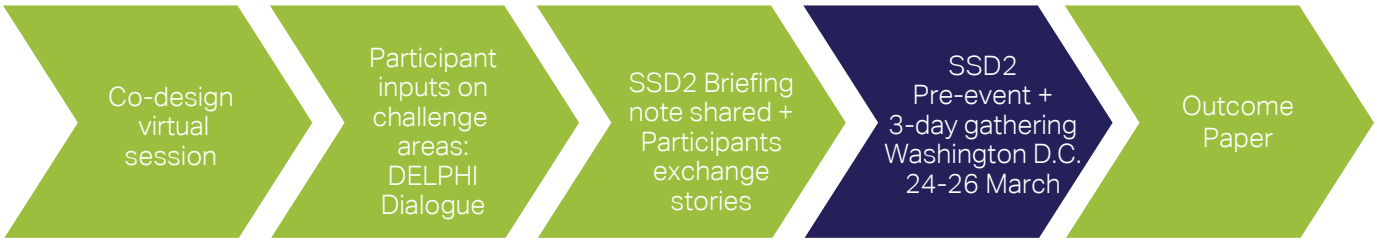
FReSH members aim to test the capacity of FReSH business solutions at scale against the science targets proposed by the EAT-Lancet Commission on Healthy Diets from Sustainable Production Systems. This Commission has brought together more than 30 international experts in nutrition, environmental sciences, food systems and policy to produce science targets that define the safe operating space for global diets and sustainable food production, setting clear guidelines for business, policy-makers and civil society. FReSH members will work to translate these scientific targets into science-based targets for business to guide solution pathways to advance progress on its shared ambition: to provide healthy and enjoyable diets for all, produced responsibly, within planetary boundaries by 2030.

The Dialogue context

FReSH members connected with leading health, sustainability and food system scientists via six science webinars in 2017. In 2018, the discussions then progressed into deeper, action-oriented dialogues through a series of SSDs that took place over three days in a face-to-face setting allowing FReSH members, scientists and civil society to discuss some of the most challenging food system issues. Each SSD was preceded by a three-week Delphi discussion (a forecasting method relying on an expert panel) in order to inform future discussions and support group convergence on the key questions to be addressed. Participants shared knowledge, expertise and experience to co-develop ways forward that offer significant opportunities to overcome challenges and accelerate the building of solution spaces to transform food systems. SSD2 benefitted from additional discussions during a Disruptive Dialogue on the same topic during the EAT Stockholm Food Forum in June 2018.

The ultimate aim of these dialogues is to inform the solution spaces for businesses and science, secure high-level CEO endorsement for the FReSH ambition, promote share understanding of the underlying science and secure recognition and support from civil society for the business solution spaces developed.

Figure 1. Science to Solutions Dialogue process



Ambition of People, Planet, Protein - What's the Plan?

The second FReSH Science to Solutions Dialogue (SSD2) discussed the role of meat production and consumption in supporting healthy and sustainable food systems. Animal meat, particularly beef, has gained significant attention as a food type where overproduction and overconsumption significantly drive both environmental degradation and poor dietary health. Lowering meat consumption in Western diets and avoiding shifts to excessive meat intake in low to middle income countries (LMICs) undergoing nutrition transitions have been identified as the most important dietary changes to improve human health – and the single most important dietary shift to reduce food system impacts on natural resources and climate. These global trends, however, mask several important caveats on the role of animal protein in improving the dietary health of vulnerable communities where malnutrition is persistent and of the potentially positive role of meat production systems in environmental conservation, restoration and circular economies.

Significant debate and uncertainty persist about how, within healthy consumption levels, meat production practices contribute to environmental degradation or restoration. To ensure that populations globally shift to healthy diets produced within planetary boundaries, scientists and business leaders need to explore a range of both animal and plant-based protein sources – along with a variety of production practices. This dialogue aimed to share scientific thinking on healthy diets from sustainable food systems in order to scope out the specific protein solutions that FReSH members could support and to direct new areas of relevant scientific research.

The Delphi exercise revealed many potential focus areas for the SSD2 dialogue, including the implementation of sustainable livestock and land management practices, the development of indicators to capture positive and negative externalities, investigations into the link between dairy production and red meat, and even investments in "clean meat technologies". The first task of SSD2 was to arrive at a shared understanding of the challenges and to define SSD2 discussion parameters. Through dialogue, SSD2 narrowed the focus to those two levers with the biggest positive health and environmental impacts: (1) ensuring that all livestock production within dietary recommendations is sustainable while (2) working to shift consumer preferences to smaller portions of red meat and other animal protein consumed less frequently, as well as to healthier and more sustainable sources of protein, especially plant protein. Importantly, the group highlighted that production systems, particularly livestock systems, need to be evaluated using a holistic set of indicators capturing the ecosystem services and restorative value of those systems.

Solution spaces

Widely **implement sustainable on-farm practices** for livestock production systems. This would require a focus on fields, rethinking feeds and feed composition, better using breed diversity and encouraging **circular production practices.**

Create the **enabling conditions for sustainable livestock systems to become mainstream**, such as setting ambitious and aligned **business goals**, creating **economic incentives** for better management practices, and developing, advancing and accelerating **sustainable livestock roundtables**.

Inspire consumers to shift to smaller portions of red meat and other animal protein and to consume them less frequently, and to shift to healthier and more sustainable sources of protein, especially plant protein, by developing **appealing, affordable and accessible** options that provide **high-quality** protein and are **scalable as well as sustainable** for businesses.

Establishing a common understanding allowed SSD2 participants to develop solutions, identify the barriers and levers for implementation, and highlight gaps in the evidence base that needed to be filled. Participants explored three complementary solution spaces: (1) on-farm practices to ensure a shift to more sustainable livestock production systems; (2) enabling conditions for the shift to more sustainable livestock production systems; and (3) inspiring consumers to shift to consuming less meat and more sustainably-produced meat, as well as more sustainable and healthful protein sources.

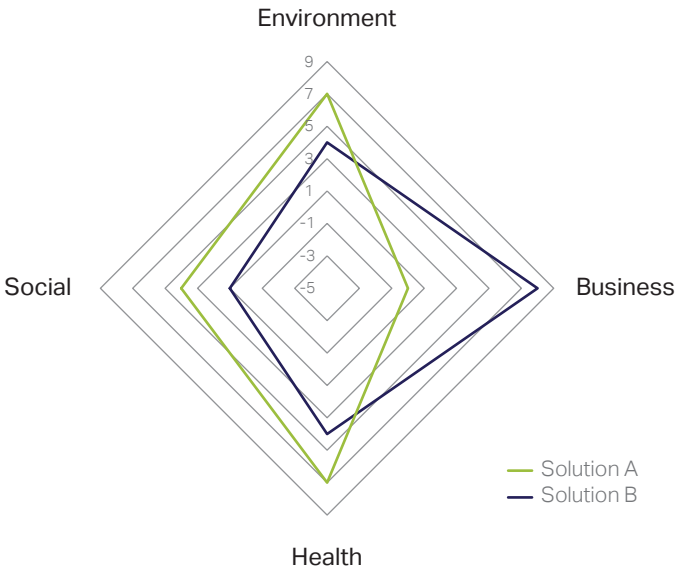
Importantly, participants stress-tested the solution spaces created over the three collaborative days. Their feedback provided direction for a future dialogue on these solutions and also highlighted the most promising focus areas. From this, four overarching messages emerged. First, alignment is essential – this includes aligning the actions and narratives of a wide group of actors, aligning the narratives within businesses and aligning the metrics and frameworks used to assess the four dimensions of health/environment/social/business impact. Second, both quality and quantity need to be considered when developing "protein solutions". Third, any sustainable meat production concept needs to be linked to healthy consumption patterns. Finally, the narrative of protein solutions needs to emphasize the true value of food.

Figure 2. Critical path for solution development

Evaluating business solutions

SSD1 recognized the need for a multi-faceted approach in order to encourage the development of solutions with synergistic effects while avoiding trade-offs. Participants developed a calibration exercise to enable the prioritization of business solutions that simultaneously support positive health and social and environmental and business impacts. SSD2 members found this to be a useful exercise but were eager to develop a more detailed semi-quantitative tool to complement and test the assumptions made. For example, the group noted that short-, medium- and long-term impacts would vary. In addition, the various solutions might impact different segments of the population in different ways. SSD2 members proposed that one way to provide for this level of specificity would be to develop more specific indicators for each of the four dimensions.

Figure 3. Tool to prioritize solutions



Open discussion points

During SSD2 and the following Disruptive Dialogue held in Stockholm in June 2018, participants did not achieve agreement on all solution spaces, especially on inspiring consumers to shift to smaller portions of red meat and other animal protein and to consume them less frequently, as well as to shift to healthier and more sustainable sources of protein, especially plant protein. Indeed, there has been a call for science to further explore the potential health, nutritional (since meat does not only provide proteins) and environmental trade-offs resulting from reducing meat consumption to more balanced levels and replacing meat with plant products.

Participants didn't settle the debate on sustainable livestock production either, with reservations about pushing for such a production shift without making sure all economic and environmental trade-offs are fully understood. Indeed, on the one hand, businesses that might have the capabilities to push for more sustainable practices and have the ability to ask for higher prices might not do it because they will find themselves in a flat or shrinking market, resulting in consumption-related concerns, which makes it very difficult for businesses to decide on transformations. On the other hand, there is a risk that businesses engaged in decreasing meat production, despite efforts to change consumption patterns, might find that meat consumption keeps growing.

Therefore, the discussion remains open; this outcome paper aims to foster further deliberations within and beyond the solution spaces described below.

Challenge areas and solution spaces

Challenge one:

On-farm practices to shift to more sustainable livestock systems

1

Common understanding of the challenge

There are a range of different meanings linked to terms such as "livestock" or "sustainable". A first task was to reach consensus on how these terms are understood in the SSD2 context. For the dialogue, **livestock** encompasses all animal meats, dairy products and eggs. Different animal-based products have different environmental impacts and different consumption-related impacts. However, increasing poultry consumption to reduce bovine meat impacts does not solve the environmental problems associated with meat overproduction and overconsumption. Sustainable production systems must match production levels with healthy consumption levels. Current consumption levels in Western countries are four to ten times greater than those recommended by the World Health Organization and the American Cancer Society.

A **production system** includes the full spectrum of intensive, extensive and industrial systems, including locally or regionally integrated and circular livestock production models. **Sustainable** production stays within planetary boundaries and is socially responsible, economically viable, environmentally sound and supportive of consumption practices aligned with national and international dietary guidelines. Staying within planetary boundaries means not converting natural ecosystems to sustain livestock or produce feed; eliminating flows of nitrogen and phosphorus surpluses into waterways; reducing, eliminating or compensating for GHG emissions stemming from food production; and maintaining freshwater flows in aquatic systems. Details of specific science targets for these boundaries will be published by the EAT-Lancet Commission in its report to be published in winter 2018-2019.

2

Solution space

Four key solution spaces emerged. First, **fields** should be used to maintain or increase soil carbon; increase resource reuse and reduce nutrient leakage; and offer restoration potential, particularly of pastures in grassland biomes. Second, re-evaluate **feed and feed composition** by reformulating feeds, increasing grass-fed livestock where grain feed is currently used, increasing/improving the use of animal production system by-products and balancing feed use efficiency with animal welfare. Third, optimize **breed diversity** for environmental compatibility and ecosystem services tailored to specific regions, e.g. by optimizing meat- and dairy-production traits. Fourth, encourage **circular production**, including locally or regionally integrated systems and the role of animal husbandry in by-product reuse.

3

Barriers and key levers

The barriers to implementing the solutions outlined above include a number of entrenched practices and ideologies. Specifically, the **legacy of specialization, preferences for specific breeds** and the fact that segmented, fragmented and ***specialized supply chains*** are commonplace limit action. Additional barriers include the **lack of private sector incentives; high transaction costs** to adopt sustainable on-farm practices; **regulatory barriers** (e.g. by-product use, biosecurity issues); and the difficulty/resource intensity of adapting solutions to specific contexts.

Importantly though, there are several opportunities. These include **valuing local lands and breeds,** offering **rewards for ecosystem services such as carbon sequestration**, shifting the focus from optimizing output to **optimizing resilience, efficiency and sustainability**, and working with developing countries to **leapfrog in the adoption of net-positive on-farm practices**. The following leverages can help harness these opportunities.

4

Evidence base

The evidence base for on-farm practices includes experiential knowledge as much as scientific evidence. For example, **many best management practices are already well-known** and can be scaled, indicating that the barriers mentioned above – rather than a lack of knowledge – are responsible for poor implementation. Yet **more context-specific examples (both business and practice) are needed.** Growing attention is being paid to feed and feed additives that can reduce methane emissions from livestock and the reformulation of feeds for monogastric livestock and to reduce impacts on land and biodiversity.

Figure 4. Leverages to help harness opportunities

FIELD AND PASTURE BIODIVERSITY AND SOIL HEALTH

- More efficient and reduced impact nitrogen and phosphorous fertilization
- Improved soil and landscape biodiversity
- Positive externalities rewarded / negative externalities taxed
- Accurate metrics for environmental sustainability to steer investment
- Water bodies protected

FEEDS AND FEED COMPOSITION

- Consumer shift to beef and dairy from animals fed on high-biodiversity grasslands
- Supplement feed with by-products (from agriculture, microbial fermentation, food waste, biofuel co-products)
- Reduction of crude protein level of feed (especially poultry and pork)
- Feeding concepts allow for efficient feed nutrient consumption at higher animal welfare standards
- Gut health as a basis for animal health and food safety

BREEDS AND ON-FARM OPERATIONS

- Consumer interest in and appreciation of locally-produced and sustainable livestock farming (positive food experience)
- Good animal welfare in intensive production
- Commercial and public investments in new breeding priorities
- Reduction of antimicrobials in livestock production
- Low burden of food safety compromising microorganisms

CIRCULAR PRODUCTION

- New business opportunities for landscape scale and agroecological production enabling a closer relationship between producers and consumers
- Efficient use of manure and of nitrogen and phosphorous with high bioavailability for plants
- Engagement with local/regional communities
- Increased use of by-products in feeds

5

Impacts

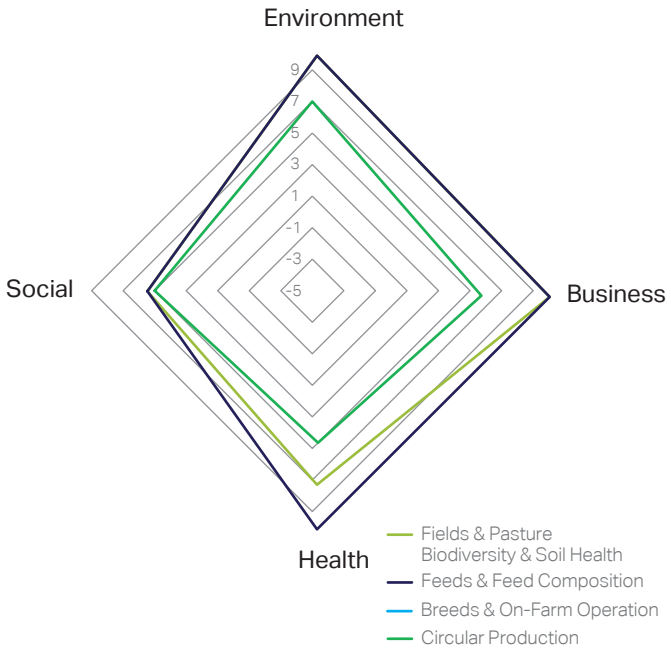
Production systems, particularly livestock systems, need to be evaluated using **a holistic set of indicators** capturing the ecosystem services provided and the social, health and business-related impacts. The preliminary evaluation of the four solution areas developed for the SSD2 protocol can only be a rough estimate; but given the sheer size of the industry and the amount of ecosystem services going into this, the impacts are very large. Therefore, it is important to work with – and not against – businesses active in livestock systems.

To evaluate the impact of the four business solution areas, SSD2 considered the size of livestock and related industries in agriculture and food processing, the consumption of major feed materials and arable land for feed production, and the carbon footprint of products for human consumption. The order of magnitude for livestock-based foods and the feeds supporting their production are derived from OECD-FAO Agricultural Outlook 2015-2024[8] and the 2017 Alltech Compound Feed Report[9], and Evonik's estimations on feed compositions for various livestock (see Annex).

The carbon footprint numbers for livestock-based products are estimates that include agriculture, livestock production and meat/product processing. It is further estimated that the non-food application of livestock-based by-products carries little commercial value.

Figure 5 shows the estimate for the business solution impact considered. The detailed estimations are available in the annex and give examples of how FReSH business solutions can be calibrated.

Figure 5. Estimate for the business solutions impact considered



Challenge two:

Enabling conditions to shift to more sustainable livestock systems

1

Common understanding of the challenge

Sustainable on-farm practices will only be widely adopted under enabling conditions. While the role of governments in creating enabling conditions is well-recognized, SSD2 put the focus on what companies can do to create enabling business, economic and political conditions. **Businesses can and must act now** to create enabling conditions for better management practices, rather than waiting for support from other sectors. Specifically, companies could work to create an environment where it is a better business case to produce sustainable livestock.

2

Solution space

Three specific actions would facilitate an enabling environment. First, adopt **ambitious, aligned business goals** with long-term return on investment perspectives and interim milestones. Second, create **economic incentives** for better management practices, with a focus on the development of a harmonized framework for **true cost** accounting of food. Third, develop, advance and accelerate **sustainable livestock roundtables** that are inclusive of all stakeholders along the value chain (figure 6).

3

Barriers and key levers

Many of the current barriers to action could also be seen as opportunities for future action. For example, two opportunities include **creating the business** case where it is currently lacking or developing a **harmonized framework for measurement, verification and reporting impacts** where there are currently many different frameworks in operation. Industry-exclusive associations can be a barrier to sustainability goals and businesses could focus on phasing these out while **accelerating the creation of inclusive, diverse roundtables and "flagship" farms** to showcase best practices.

Figure 6. Livestock supply chain and value chain

4

Evidence base

More evidence is needed to understand how the **true cost of food would impact consumption trends** and food purchasing decisions. There are also uncertainties as to how **true cost would impact farmer and company sustainability behavior.** The **equity issues of implementing true cost** for low-income individuals also need to be better understood and challenged against the assumption that these costs are necessarily born by the consumer.

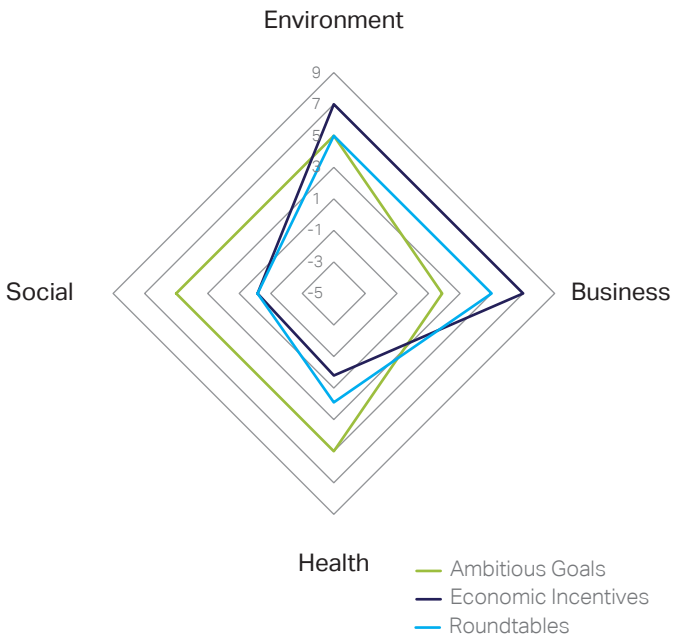
There is also a lack of evidence-based data analyzing the **relationship between agricultural practices and human health, as well as agricultural practices and social impact.** To move forward with a harmonized framework of metrics, a majority of scientists, industry and civil society must agree upon science-based targets.

5

Impacts

Each of the three solutions developed to create enabling conditions ranked highly on at least two of the four dimensions of health, environment, social and business. Scores of zero indicate uncertainties, notably about the social impact of the proposed solutions. These uncertainties highlight where FReSH is tackling largely unexplored territory, given that there are few standardized frameworks that characterize the social impacts of business decisions.

Figure 7. Calibration of sustainable production – enabling conditions solutions



Challenge three:

Inspire consumers to shift to more sustainable and healthier protein choices

1

Common understanding of the challenge

Businesses need to **remove barriers** to help consumers become receptive to a shift to recipe and menu choices that are less dependent on meat as well as to high-quality protein sources that are **scalable, healthy, sustainable, affordable and appealing which can also be informed by the consumer work of SSD1 Putting Food in Food which looked at the biological underpinning of making products appealing.** A very large segment of the population is open to new ideas, but there is wide variation in consumer willingness to try innovative options. As a result, producers **need to develop, test and present a variety of options**.

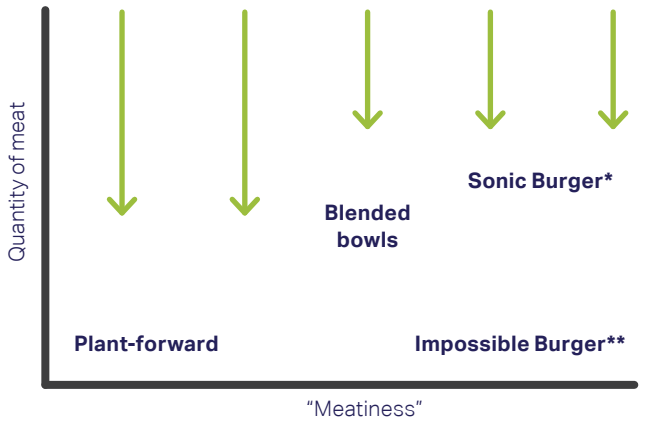
Figure 8. High-quality protein source conditions

2

Solution space

The variety of solutions includes developing **appealing new culinary strategies, menu concepts and recipes** to encourage behavior shifts to healthy and sustainable amounts of animal sources of protein. Businesses could develop a range of new products to **encourage the adoption of healthy, high-quality protein** sources that include a greater proportion of plants through, for example, blended animal/plant protein products (figure 9). Companies can **identify scalable, sustainable protein sources**, such as insects, pulses, fish, algae, etc., and then address the supply chain, agricultural and regulatory challenges that prevent taking the product to scale. A variety of accessible and affordable protein solutions can also be provided by **making connections from farm to food in meal settings**, such as schools and other food service channels.

Figure 9. Alternative protein sources



*Sonic Burger blends mushroom and beef
**Impossible Burger is 100% meat free yet looks and tastes like a beef burger

3

Barriers and key levers

Focused market research, including how marketing can be used to **sell the experience** (rather than selling health or sustainability explicitly) should guide the variety of options developed. Novel solutions, such as meal kits, might come at a premium to the consumer, so producers will need to **find lower cost options**.

Businesses will need to address **supply chain challenges** when they identify new protein sources as scalable and sustainable. In addition, regulation should enable the roll-out of these new protein sources. For some of them, such as insects for example, new **regulatory frameworks** are needed to classify these proteins, to outline appropriate feedstocks when relevant, and to outline the appropriate use of resulting ingredients.

4

Evidence base

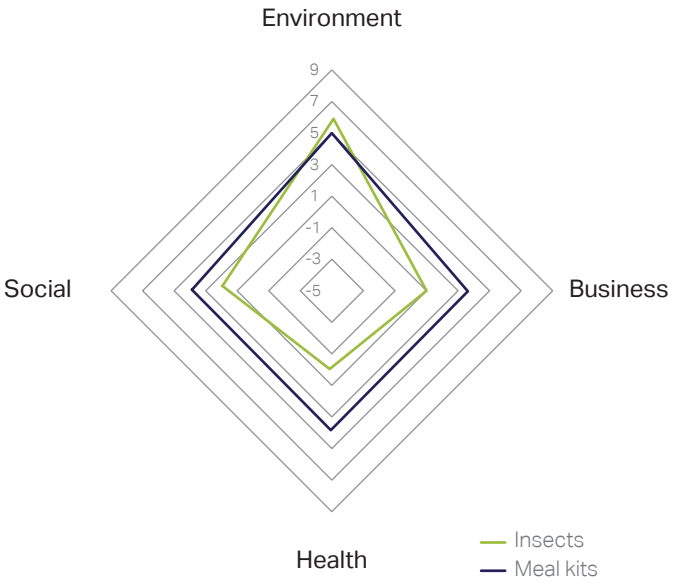
Stakeholders will need more **life-cycle analysis (LCA) data** in order to quantify the impacts of producing novel proteins – particularly for cellular agriculture. Additionally, they will also need to better understand the **overall health implications** of these novel proteins. Further research could focus on the **safety and sustainability of feed stocks** and finished products.

5

Impacts

Figure 10 below illustrates the health, environment, social and business impacts of two particular solutions – the development of meal kits and the scaling up of insect proteins. These are by no means exhaustive. By addressing the knowledge gaps and barriers, the potential for higher net-positive impacts on these four dimensions is likely.

Figure 10. Business impacts of meal kits and insect proteins



FReSH offers a unique space to advance these ambitious solutions

FReSH, WBSCD and EAT have a role in supporting the specific solutions put forth by "People, Planet, Protein", and also in championing the required change on global platforms. In particular, these organizations recognize their responsibility to: 1) create and amplify a new narrative; 2) build the business case for action; 3) emphasize the value of food; 4) connect production to consumption; 5) normalize multi-sector/stakeholder collaboration; and 6) connect with consumers.

Not a full consensus

This dialogue did not gain full consensus on:

- Nudging people to consume smaller portions of red meat and other animal protein and to do so less frequently, and to consume healthier and more sustainable sources of protein, especially plant protein; and
- Pushing producers toward sustainable livestock production without making sure all economic and environmental trade-offs are fully understood.

1. Create a new narrative

- Create and amplify a new narrative, one that insists that healthy diets include quality protein amounts that support optimal human health, produced sustainably within planetary boundaries.
- Highlight the role of food as a powerful tool to leverage synergistic, regenerative, net-positive impacts across the dimensions of health, environment, society and business.
- Emphasize the variety of solutions that meet health and sustainability criteria.
- Shift the narrative to focus on quality (health+environment+social) in addition to quantity.
- Ensure this narrative is adopted across the entire value chain.
- Place consumers, producers and farmers at the center of this vision.
- Plan the move to mainstream on a two-year timeframe.

2. Build the business case for action

- Develop the evidence base for pre-competitive and business-specific action and clear metrics that allow for multiple solutions.
- Work with key business leaders to embed these initiatives into business operations and strategies.

3. Emphasize the true value of food

- Support the creation of a harmonized "true cost/value" framework, capturing positive and negative externalities.
- Learn from other sectors that have worked to internalize externalities (e.g. sugar pricing).
- Identify the business incentives.

4. Connect production to consumption

- Ensure that the solution space includes only products that are both produced sustainably and have a healthy nutrition profile.
- Ensure that production and consumption solutions are not pushing and pulling at the same time (e.g. the goal of decreasing meat consumption in many populations would clash with the goal of increasing sustainable livestock production).

5. Gain support from other sectors

- Phase out exclusive associations entrenching an agenda counter to health and sustainability goals.
- Use the business case and "sticks and carrots" to get those who are not at the table on board.

6. Connect with consumers

- Engage with civil society to ensure that solutions are designed for specific populations.
- Provide a spectrum of options that are "craveable", ranging from imitation meat to new blended protein experiences or "bowls" with new combinations of foods.

Participants

We would like to thank the participants who came to the table with open minds and ambitious ideas.

Research scientists and educators

Todd Crane, ILRI
Gina Kennedy, Bioversity
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ANNEX:
Estimation of the impact of business solutions for on-farm practices to shift to more sustainable livestock systems

Depending on the source and assumptions about feed composition, crop and forage yields, feed conversion rates, and commercial allocations of by-products, numbers may easily vary by +/- 30% on an individual basis; however, the complete picture for livestock-based products is in line with many other publications.

Livestock carbon footprints

Poultry meat and eggs (broiler, turkey, eggs)

Globally 120 million metric tons (carcass weight) of chicken, turkey, goose and duck meat are produced, largely in integrated feed and meat production and processing businesses; 55 million hectares of arable land (4% of total arable land) is used for feed ingredients, mainly comprising 170 million metric tons of grain (9% of total grain production) and 90 million metric tons of oilseed meal (30% of total oilseed meal production). With an estimated carbon footprint of 2.5 kg CO_2e per kg of product for human consumption and 80% of **poultry carcass weight for human consumption, poultry meat contributes to 370 million metric tons CO_2e (0.7% of total global GHG emissions).** By reducing the amount of oilseed protein meal in feed from 29% to 19%, the arable land needed for feed production could be reduced from 55 to 42 million hectare.

Pork meat

Globally 120 million metric tons (carcass weight) of pork meat are produced in integrated feed and meat production operating on high-density compound feed (60% of all pig feed), in backyard farming (esp. in China), and in smaller pig farm operations with farm-mixed feed; 65 million hectares of arable land (5% of total arable land) is used for feed ingredients, mainly comprising 280 million metric tons of grain (14% of total grain production) and 85 million metric tons if oilseed meal (28% of total oilseed meal production). With an estimated carbon footprint of 5 kg CO_2e per kg of product for human consumption and 60% of carcass weight for human consumption, **pork meat contributes to 990 million metric tons CO2e (2 % of total global GHG emissions).** By reducing the amount of oilseed protein meals in feed from 19% to 9%, the arable land needed for feed production could be reduced to from 65 to 47 million hectares.

Not considered here is the possibility of improving local breeds of pigs (and other livestock). For example, in Vietnam there are over 60 breeds of pigs, which all have much lower productivity than commercial breeds used in Europe – starting from piglet production and survival, through to meat yields. This is a long-term solution, but genetics through to husbandry improvements all have a part to play. Genome screening techniques help to bring this through faster than traditional breeding, without having to impose European breeds, which will not have the same local appeal.

Beef, goat, sheep meat

The majority of the global population (approx. 70%) of cattle, sheep and goats are not accessible for business solutions, since they belong to smallholder farmers or have no clear ownership. Globally, 80 million metric tons (carcass weight) of ruminant meat (from beef cattle, sheep, goats) are produced. Only 20% of the feed is compound feed. The majority of animals are held in grazing and are fed with forage, grain, distillers' grain and other low-quality protein sources, coated urea and other nitrogen sources during parts of their life span; 90 million hectares of arable land (6% of total arable land) is used for feed ingredients, mainly comprising of 156 million metric tons of grain (8% of total grain production) and 47 million metric tons of forage dry matter. With an estimated carbon footprint of 20 kg CO_2e per kg of product for human consumption and 60% of carcass weight for human consumption, **ruminant meat from private sector operations contributes to 2.6 billion metric tons CO_2e (5% of total global GHG emissions).**

Eggs

Globally 73 million metric tons of eggs are produced, largely in integrated feed and egg production operations on high density compound feed; 26 million hectares of arable land (2% of total arable land) is used for feed ingredients, mainly comprising 112 million metric tons of grain (6% of total grain production) and 35 million metric tons of oilseed meal (12% of total oilseed meal production). With an estimated carbon footprint of 2 kg CO_2e per kg (100% for human consumption), **eggs contribute to 146 million metric tons CO_2e (0.3 % of total global GHG emissions).** By reducing the amount of oilseed protein meals in feed from 22% to 12%, the arable land needed for feed production could be reduced from 26 to 15 million hectares.

Whole milk (buffalo and cow)

Globally, 800 million metric tons of whole milk are produced and build the raw material basis for the dairy industry. Compared to meat cows, dairy cows consume feed with much higher protein content. Again, compound feed is limited to about 20% of total feed consumed; 107 million hectares of arable land (8% of total arable land) is used for feed ingredients, mainly comprising 209 million metric tons of grain (11% of total grain production), 35 million metric tons of oilseed meal (12% of total oilseed production) and 450 million metric tons of forage dry matter. With an estimated carbon footprint of 1.5 kg CO_2e per kg, **whole milk contributes to 1.198 billion metric tons CO_2e (2.4% of total global GHG emissions).** By reducing the amount of oilseed protein meals in feed from 5% to 2%, the arable land needed for feed production could be reduced from 107 to 99 million hectares.

Livestock economic values

Livestock-based products accessible to private sector initiatives are a large part of the USD $3,000 billion distribution value of animal-derived products. Within this market, there is a niche for high-value livestock producers (EU Bio, USDA organic, slow food producers, niche producers with local breeds and the highest animal welfare standards, etc.) with a distribution value of USD $10 billion globally (approx. 10% of global organic food retail value). The distribution value of livestock from smallholder operations in Africa and India, as well as many products that are produced in agroecological farming approaches, are not part of this analysis.

The evaluations that served to create the diamond graph (figure 5) for **on-farm business solutions are** based on the following estimates of industry size and natural resource consumption. On each axis (environmental, social, health and business dimension), the impact ranges from Minus 5 to Plus 10, hence "Plus 9" below correspond to the score of one given solution on one of the four axes.

I. Environmental dimension

Fields and pastures

As livestock-based products use 25% of global arable land for feed production, any business solutions to improve biodiversity and soil quality have a high impact: **Plus 9**

Feed

As livestock feed consumes 48% of global grain production and nearly 100% of global oilseed meal production (soy, rapeseed meal, sunflower as most prominent), any changes in livestock feed to reduce inputs, increase nutrient-use efficiency and reduce nitrogen and phosphorous outputs will have the largest sustainability impact across the entire value chain, from farm to fork. By reducing the use of oilseed protein meals in livestock feed, 45 million hectares of high-quality arable land (approx. 25% of the South American Cerrado) and 110 million metric tons of oilseed meal (approx. 90% soy bean meal) can be saved with existing concepts and nutritional solutions at a higher proficiency level of farm animal feeding. This means, approx. 30% of global soybean meal production would not be needed to feed livestock. As about 50% of this production comes from agricultural areas with endangered natural habitats, restoring these areas would remove significant amounts of CO2 from the atmosphere. Additionally, such measures would reduce the emission of reactive nitrogen by approx. 20% and the consumption of water in livestock operations by 20%: **Plus 9**

Breeds and livestock operations

Breeds and livestock operations (housing, stocking density, free range, etc.) can help to align animal welfare standards with efficient feed nutrient consumption. In particular, slower growing animals that have lower energy and nutrient content in feed requirements can add benefits to the ones already addressed under the feed solution area: **Plus 2**

Circular farming

Circular farming is tightly connected to the other three opportunity areas. The biggest impacts are (i) the use of manure (as volatile solids) as energy sources for heat, electricity and fuel in crop agriculture, livestock farming and meat processing, and (ii) the use of manure nitrogen and phosphorous nutrients as fertilizers, if processed properly for high plant availability: **Plus 2**

Adding the use of by-products in feeds would probably bump up the impact score to at least 5.

II. Social dimension

Fields and pastures

Keep population, capital and investment in rural areas (high precision agriculture approaches, etc.): Plus 2 (and up to 4, as it keeps rural employment, especially as there is a general urbanization trend globally).

Feeds

Allows for the use of local or regional sources of feed material and allows small livestock producers to achieve environmental sustainability standards set forth by retail and food services. Solutions work for compound feed and for farm-mix feed: **Plus 3**

Breeds and livestock operations

Makes livestock farming much more attractive and is a key aspect in improving the reputation of livestock farmers in society, making the job attractive for young people: **Plus 5**

Circular production

Puts additional investment and innovation in rural areas. By introducing landscape-scale integrated food production models and mainstream agroecological livestock farming, this business solution area can have positive social impacts. However, the still very small fraction of overall livestock production will limit its global impact even at very high growth rates. New technologies (blockchain, etc.) can play a role in reducing market entry hurdles for new solutions, since the food chain is very conscious about food safety, which limits the application of circular approaches because of poor traceability: **Plus 3**

III. Health dimension

Fields and pastures

No health impacts: **level 0**

Feeds

A reduction of NH4 (ammonium) emissions in livestock operations has positive health effects on farm labor and reduces the formation of inorganic microparticles: **Plus 2**

Breeds and livestock operations

The spread of antimicrobial resistance, improved food safety and reduced risk of spreading animal-borne diseases (for example bird flu, swine fever) are positively affected and have a significant societal and public health impacts: **Plus 9**

Circular production:

No health impacts: **level 0**

IV. Business dimension

Fields and pastures

Will largely impact the USD $120 billion fertilizer, USD $150 billion farm machinery, USD $50 billion agrochemical, and USD $50 billion seed industries. The reduction of fertilizer use globally will significantly reduce the environmental footprint of animal-based protein sources. Effects will not only be limited to animal-based products but to all crop and vegetable production, with an estimated production value of USD $2,000 billion: **Plus 9**

Feeds

Solutions can be quickly implemented in fully integrated livestock operations and will be the highest impact business solution for the USD $3,000 billion livestock products industry. A key solution provider will be the USD $20 billion feed additive industry and the many industries delivering feed materials, with a combined market value of approx. US $2,000 billion (biofuel, food processing, processing of agricultural crops, fish processing, rendering industry): **Plus 9**

Breeds and livestock operations

In particular, animal welfare concerns and consumer and society perceptions of livestock operations are driving the low value perception of meat and animal-based products in Western countries. If the industry is faced with flat to negative growth rates, it will be crucial to increase the value perception of the products and increase prices. The dominant business rationale of maintaining profitability in a consolidating market by increasing economies of scale will see severe limitations. Better breeds, high animal welfare, and high food safety livestock farming will be key for consumer acceptance in these countries. These practices will help avoid costly disruptions in global trade due to food safety concerns.

Key solution providers will be the USD $12 billion farm animal health, USD $20 billion feed additive, US$ 5 billion breeding stock, USD $2 billion farming equipment, and USD $10 billion meat processing equipment industries. New services around data integration and analysis (artificial intelligence, block chain, platform business models, etc.) will evolve for livestock as well as for crop agriculture: **Plus 9** (at least for the Western world, **possibly less** in emerging and developing economies).

Circular production

The most relevant investments for the established industry will be those linked to biogas production and refining, presently a USD $30 billion global industry, and fertilizer manufacturing from manure and/or biogas digestate. Additionally, new technologies and services can generate an entire new market segment that is not visible today. But even at high growth rates, the overall global impact will be limited: **Plus 2**. Can increase this by considering the use of by-products in feeds here as well.

About FReSH

FReSH is an ambitious global business partnership that brings a consumption lens and systemic approach across the food system to drive industry change.

We turn the conventional 'farm to fork' approach on its head by working from "fork to farm" to develop, implement and scale transformative solutions that are aligned with science-based targets.

This means we start with people, focusing on their consumption habits. Then we work back through the food system – from retail, packaging and distribution to how and what we grow – to determine what levers business can pull to contribute to food system reform in order to create healthy, enjoyable food for all, produced responsibly, within planetary boundaries by 2030.

FReSH was jointly launched in January 2017 by the EAT Foundation (EAT) and the World Business Council for Sustainable Development (WBCSD), and 25 founding member companies. The total membership has since grown to almost 40 companies.

About the World Business Council for Sustainable Development (WBCSD)

WBCSD is a global, CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world. We help make our member companies more successful and sustainable by focusing on the maximum positive impact for shareholders, the environment and societies.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than $8.5 trillion and 19 million employees. Our Global Network of almost 70 national business councils gives our members unparalleled reach across the globe. WBCSD is uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

Together, we are the leading voice of business for sustainability: united by our vision of a world where more than nine billion people are all living well and within the boundaries of our planet, by 2050.

www.wbcsd.org

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Credits

About the EAT Foundation (EAT)

EAT is a catalytic organization linking food, health and sustainable development across science, business and policy. Originally launched three years ago, EAT includes three core partners: The Stordalen Foundation, the Stockholm Resilience Centre and the Wellcome Trust. The overall objective of EAT is to expand scientific knowledge on the interconnections between food, health and environmental sustainability, spur innovation along the food value chain, and facilitate the development of evidence based policies to radically transform the global food system to be able to deliver healthy, affordable diets to a growing world population within planetary boundaries. Multi-stakeholder, multidisciplinary and multi-scale collaboration between business, science, politics and civil society lies at the heart of EAT's work. EAT believes that a transformation of the food system is only possible if these diverse actors collectively address the intertwined issues of food, health and sustainability, and develop integrated strategies on food production and consumption to leverage multiple benefits for human and planetary health.

www.eat.org

Disclaimer

This report is released in the name of WBCSD. Like other WBCSD publications, it is the result of a collaborative effort by WBCSD staff, experts, and executives from member companies. A wide range of members and experts reviewed drafts, thereby ensuring that the document broadly represents the perspective of the WBCSD membership. It does not mean, however, that every member company and partner agrees with every word.

EAT is a non-partisan, non-profit organization devoted to fixing the global food system. The challenges we face are complex and intimately intertwined. Thus, our actions must be integrated across sectors, disciplines and countries. Inviting different perspectives to be part of the conversation is necessary to develop holistic solutions. The views and opinions expressed by our programs, partners and our event participants are their own and do not necessarily represent those of EAT, nor do they represent an endorsement by EAT of any company, service or product.

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