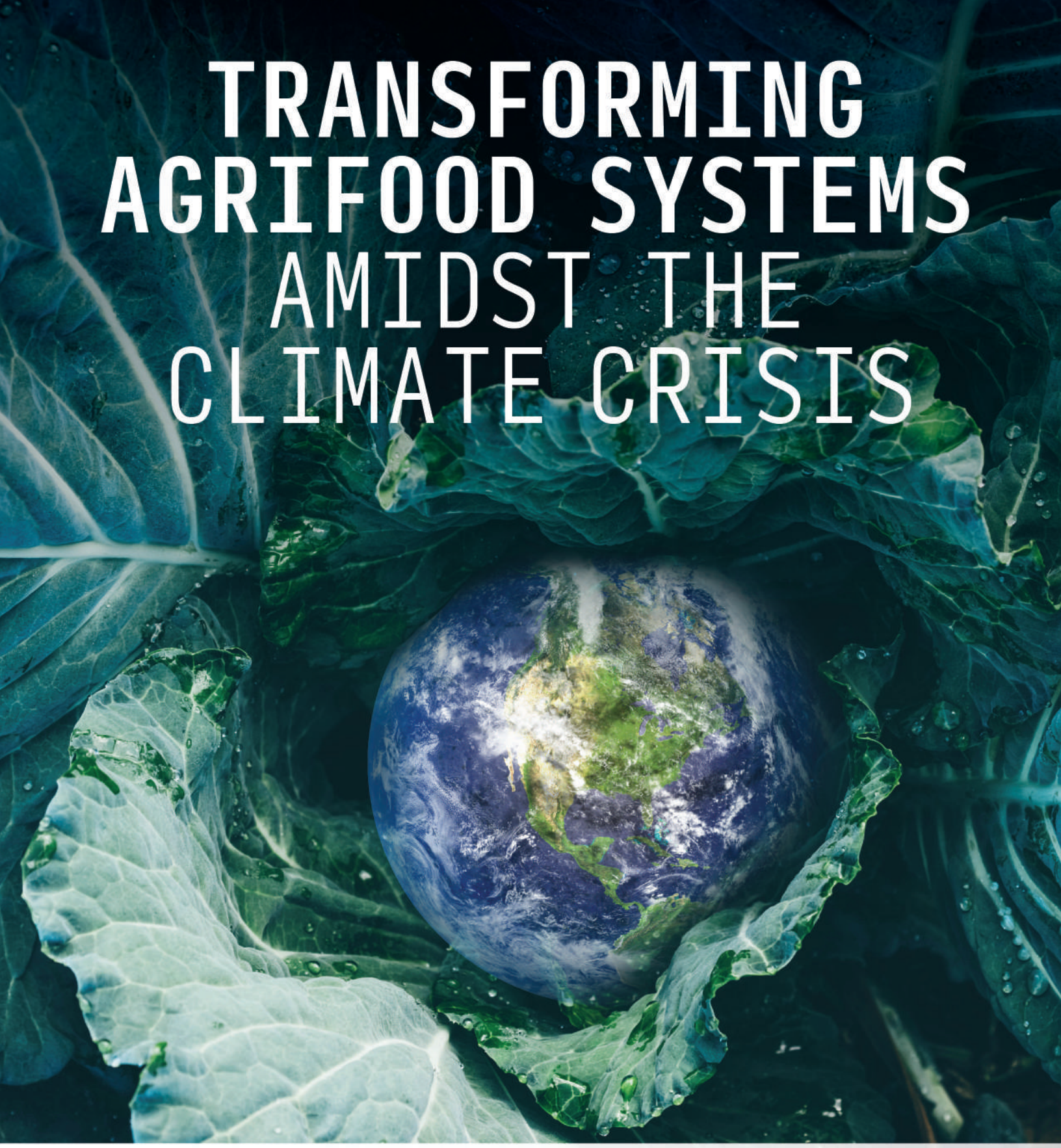
TRANSFORMING AGRIFOOD SYSTEMS AMIDST THE CLIMATE CRISIS



A Diversity of Solutions for People, Planet, and Prosperity

Letter from the Co-Chairs

Agrifood systems are complex, diverse, and inextricably entrenched in our social, economic, and cultural landscapes. The United Nations defines food systems as the range of stakeholders, including the innovators of science and technology across the value chain, involved in the production, processing, distribution, sale, consumption, and recovery of food in all its forms, alongside the broader economic, societal, and physical environments in which these activities are embedded.[1]

In an age of abundance—when our technologies have extraordinary capabilities and business innovations abound—our agrifood systems are failing. And, communities that are underserved disproportionately bear the health, climate, and economic burdens. Worldwide, 3.1 billion people cannot afford a diverse, nutritious diet.[2] Forty-five million children under age five suffer from wasting and 148 million suffer from stunting.[2] An estimated 700 million people will have diabetes by 2045,[3] with poor diet causing the majority of these cases.[4] Overall, poor nutrition is a leading cause of premature death and major chronic diseases globally.[5] Malnutrition in all its forms, and the associated health inequities, are pervasive and deadly.

The agrifood systems' impact on planetary health is catastrophic. The United Nations Framework Convention on Climate Change confirms that food production is a primary contributor to climate change, accounting for over one-third of global greenhouse gas (GHG) emissions. It is also a leading cause of biodiversity and freshwater losses, and is driving the depletion of forests, marine ecosystems, and other natural habitats. Roughly two-thirds of agrifood related GHG emissions arise directly from agricultural production and land use changes, with the remainder originating from energy-intensive food processing, transport, packaging, and food retail activities.[6] Harms are bidirectional; climate change further strains our agrifood systems' adaptive capacity and people's consistent access to healthy foods. To solve for climate, we must solve for food.

Together, current agrifood-systems generate intrinsic health, environmental, and poverty costs estimated at almost US$ 12 trillion a year for People and Planet—a number larger than the value of the agrifood systems' world output at market price.[7] In other words, for every dollar of economic value from food production, the global economy is losing more than a dollar. This is not a formula for global prosperity.

WE MUST EMBRACE THAT AGRIFOOD SYSTEMS ARE JUST AS MUCH CULPABLE FOR AS THEY ARE AN INDISPENSABLE SOLUTION TO THE ACCELERATING GLOBAL HEALTH, CLIMATE, AND POVERTY CRISES OF OUR GENERATION.

With all these challenges, there is good news: we know what it takes to successfully respond. The global food and nutrition crisis can be addressed through multisectoral investments in scalable, resilient, market-driven enterprises—from farm to fork—that support more sustainable and equitable agrifood systems and improve the health outcomes of all people, respect the planet, deliver financial return for all stakeholders, and ensure geography and income are not barriers to nutritious, delicious, and affordable food.

No single solution will deliver a just transformation of agrifood systems for People, Planet, and Prosperity. A diversity of solutions is required, working across different time horizons, scales, challenges, and value chains. For example, more advanced tools allowing for precise measurement can prevent overuse of pesticides and fertilizers that pollute water and contribute to GHG emissions. Renewal of traditional knowledge in farming practices like regenerative crop rotation and reintroduction of diverse, climate-resilient, and nutritious local food grains and grasses will be restorative to our ecosystems. Sustainable wild fisheries, livestock, and aquaculture management, coupled with innovation in alternative protein sources from plants, algae, fungi, and beyond can also advance more efficient, climate-friendly, and nutrition-forward food production. Producers, distributors and other cold chain, retail outlet, and food service actors all must innovate to reduce food loss and waste.

Connectivity and collaboration across supply chain stakeholders must accelerate, while simultaneously safeguarding and strengthening fair labor practices for all actors. Across the value chain, the operations, activities, and strategies of private sector businesses must be aligned to make a sustainably produced, balanced, healthy, and appetizing diet the affordable, available, and attractive choice for all—while strengthening planetary health.

These are not impossible dreams, but achievable—and essential—goals. However, the window of time remaining to leverage global will and financial capital to keep us from the brink of an agrifood systems collapse is rapidly closing. At COP27, food and agriculture for the first time achieved a greater presence. Lamentably, this did not translate to firm commitments or recognition of food and agricultural actions in the final Leader's Declaration.

In 2023, COP28 offers a crucial opportunity to elevate food and agriculture as a core component of global, equitable climate action and financing with strategic, long-term, and commercially viable solutions. This Report aims to educate, empower, and mobilize diverse policymakers, private asset managers and owners, and business executives towards agrifood systems transformation with far greater and more equitably distributed health, climate, and financial returns for all.

IN THIS REPORT, WE WILL:

- ➔ *Describe how agrifood systems transformation is fundamental to ensuring nutrition, health, and well-being; mitigating and adapting to accelerating climate change; and securing livelihoods for all stakeholders.*
- ➔ *Encourage fit-for-purpose financing mechanisms and business models to meet the diverse risk and return profiles of agrifood systems solutions.*
- ➔ *Illustrate how the complex global food crisis can only be solved with a diversity of solutions that recognize and manage the complex trade-offs that exist between climate, health, and livelihood goals, and how these may differ across stakeholders, geographic contexts, and temporal scales.*
- ➔ *Propose the Impact Fingerprint for evaluating these trade-offs across impact dimensions and considerations when evaluating a given agrifood systems solution.*
- ➔ *Highlight the urgency of building science-based, real-time agrifood systems impact measurement and management and data systems to inform the continuous improvement of agrifood systems solutions and drive greater business accountability and transparency.*
- ➔ *Champion specific, innovative solutions that embrace nuance and connectivity, balance trade-offs, and deliver on equitable returns for People, Planet, and Prosperity.*
- ➔ *Catalyze policymakers, private finance, and businesses with an ambitious yet achievable call to action around our shared vision, creating an expanded and effective coalition of champions for agrifood systems transformation.*

The most pressing human and planetary health challenges of the 21st century revolve around the food we produce, process, distribute, sell, and consume. The roadmap to ensuring health and health equity, achieving the Paris Climate Goals, and securing equitable livelihoods hinges on embracing a diversity of solutions, measuring and managing impact trade-offs across these goals, and mobilizing innovative funding mechanisms around an audacious and just agrifood systems transformation.

In solidarity,

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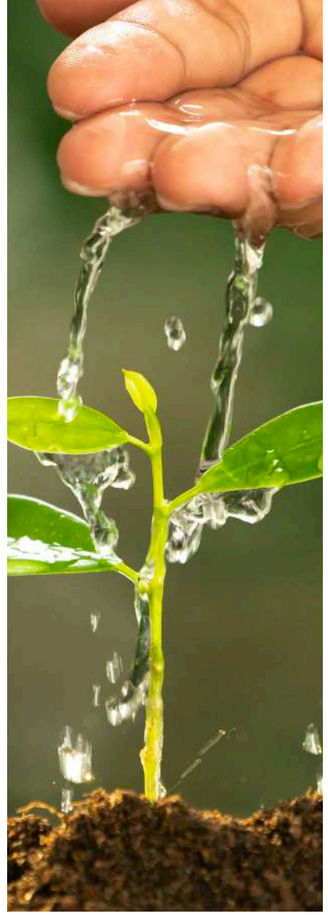

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Acknowledgements

The authors would like to thank the scientific experts from the Food Systems Countdown Initiative for their valuable inputs on their global indicator architecture which directly informed our Impact Fingerprint framework. We would also like to thank Mike Wise (S2G Ventures) and Gray Harris for their expert review of key components of the report. Finally, we extend tremendous gratitude to Ink & Pixel Agency, the creative agency that supported the creative design and formatting of this report.

ABOUT ENVIRONMENTAL DEFENSE FUND

Environmental Defense Fund's (EDF) mission is to build a vital Earth for everyone. By leveraging their deep expertise in science and economics, EDF delivers bold, game-changing solutions to address the biggest challenge of our time—climate change. EDF's team of biological and social scientists, lawyers, economists, and other specialists works with communities to stabilize the climate, and to strengthen the ability of people and nature to thrive and support people's health. From slashing pollution caused by transportation around the world, to slowing global warming by cutting methane pollution, to bolstering nature's own capacity to stabilize the climate, EDF partners with other organizations—as well as with businesses, governments and communities—to get the world on a rapid path to climate stability. **Learn more at www.edf.org**

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The Food is Medicine Institute (FIMI), directed by Dr. Dariush Mozaffarian, is a new cross-university effort at Tufts bringing together faculty and students from the Friedman School and Tufts University School of Medicine, and collaborating with Tufts Medicine to advance research, training, patient care, and community engagement around FIM. This first-of-its-kind Institute will lead the nation in collaborative, high impact efforts to transform healthcare by integrating high-value food-based nutritional interventions and related programs as therapeutic and preventive interventions. The Institute will serve as a catalyst to drive change, improve health, reduce health disparities, and create a more equitable and resilient healthcare system that recognizes the power of food as medicine.
Learn more at www.tuftsfoodismedicine.org/

Key Take-Aways

1. Solving the accelerating climate crises of today requires bold mitigation of our agrifood systems' toll on the environment and real-time adaptation to the growing challenges climate change is already presenting for food producers' livelihoods, food security, and nutrition and health for all.

2. We will need a diversity of solutions, operating across different geographic and temporal scales in agrifood value chains to drive the systems change required to address the global human health, climate, and poverty crises of today.

3. Solutions to our modern food crises will be found in systems rather than siloed approaches, by championing connectivity and circularity across agrifood systems value chains, and collaboration between policymakers, private finance, business, and other actors.

4. Science-based, real-time impact measurement and management tools are vital to understand, navigate, and make informed decisions around the complex trade-offs that exist for People, Planet, and Prosperity.

5. To accelerate agrifood systems transformation, we need to diversify public and private financing mechanisms and build the investment case for commercially-viable solutions. Public, private, and philanthropic capital need to work together to make investments across the value chain that also benefit producers (farmers and fishers), consumers, and downstream communities, as well as the environment—looking beyond the traditional bottom line.

AGRIFOOD SYSTEMS TRANSFORMATION IS FUNDAMENTAL

To Achieving Global Health and Nutrition Goals

Malnutrition presents one of the greatest societal challenges of the 21st century, with widespread health, social, and economic implications globally. Agrifood systems[1] are a major driver, and therefore solution, to malnutrition in all its forms. While adequate access to and consumption of nutritious foods supports and ensures health and well-being, the contrary leads to acute (wasting) and chronic malnutrition (stunting), as well as diet-related chronic diseases such as obesity, type 2 diabetes, and cardiovascular disease.

The statistics paint a grim picture of the state of nutrition and its health, social, and economic impacts. Currently, 3.1 billion people are unable to afford a diverse, nutritious diet.[2] And, malnutrition, diet-related non-communicable diseases (NCDs), and associated health inequities are worsening.

Nearly 30% of the global population experiences moderate or severe food insecurity.[2] Worldwide, 45 million children under age five suffer from wasting and 148 million suffer from stunting, with higher prevalence in rural areas than urban areas.[2] Wasting and stunting during childhood induce a variety of negative health and economic consequences, such as increased susceptibility to disease and reduced earning potential,[3,4] particularly in low- and middle-income countries (LMICs). Apart from the human suffering that it induces, childhood stunting also costs an estimated US$ 135.4 billion in lost sales annually across 95 LMICs striving to improve their economic status.[5]

Poor nutrition is also a leading cause of premature death and NCDs.[6] In 2019, 74% of all deaths (41 million) and 63% of all disability-adjusted life-years (1.6 billion) globally were caused by NCDs. The estimated economic burden of life lost due to the top four NCDs, cardiovascular disease, cancer, chronic respiratory disease, and diabetes, is predicted to reach US$ 27 trillion by 2030.[7,8]

How have we found ourselves in this dire state?

3.1 *billion people globally* ARE UNABLE TO AFFORD A DIVERSE, NUTRITIOUS DIET	**30%** *of the global population* EXPERIENCES MODERATE OR SEVERE FOOD INSECURITY	**US$ 27** *trillion economic burden* OF LIFE LOST DUE TO TOP 4 NCDS
148 *million children* SUFFER FROM STUNTING	**45** *million children* UNDER AGE 5 SUFFER FROM STUNTING	**74%** *of deaths in 2019* WERE CAUSED BY NCDS GLOBALLY

At the current pace, the world is not on track to meet the United Nations Sustainable Development Goals (SDG) target to reduce premature mortality from NCDs by one-third or to achieve the targets set for reducing child wasting and stunting.[2,9]

Modern agrifood systems have not evolved with the science, innovation, business, and policy to actions required to meet the health challenges of today; to weather the mounting man-made and climate-related shock and stresses; nor to equitably deliver access to nutritious foods for all. Current agrifood systems were built to address the scientific discoveries and recognized challenges of the 20th century: vitamin deficiency diseases, and sufficient calories for a burgeoning global population. Bringing together scientific advances, government policy, and private sector innovation, we were successful: vitamin deficiencies, hunger, and starvation were each greatly reduced over the last five decades. These successes should not be ignored.

At the same time, although scientific, policy, and private sector advances provided more calories and vitamins, we unintentionally created agrifood systems that have accelerated 21st century problems of metabolic dysfunction, diabetes, adiposity, and related conditions.[10] For example, food processing techniques (i.e., pasteurization, drying, freezing) have greatly increased the safety and longevity of food; however, ultra-processed foods (e.g., chemical modifications, use of additives to make products palatable or hyper-palatable) have been found to pose risks to human and planetary health.[11,12,13,14,15,16]

A myriad of other factors and weaknesses in agrifood systems further contribute to the current malnutrition crisis. Man-made conflict[17] and natural disasters[18] can greatly disrupt the supply chain. Resilient agrifood systems are necessary to withstand the current and future shocks and stressors and subsequently ensure food and nutrition security are not compromised.[19] Social justice issues such as systemic racism, social inequities, and disparities in education and income drive nutrition and health inequity across the globe, which are further exacerbated by seismic events such as the COVID-19 pandemic.[20] Finally, the state of research and science, and associated innovation, is inadequate given the size of the needs and challenges of today.[21]

Global agrifood systems transformation is required to better meet the diverse nutritional needs of global populations in an equitable and unified manner. From farmers and producers to packagers and transporters, local, national, regional, and global agrifood systems must align to ensure the accessibility, affordability, and awareness of nutritious, delicious, culturally-relevant foods. This global transformation will require a diversity of solutions with coordinated action to result in meaningful and measurable improvements in health and well-being for all.

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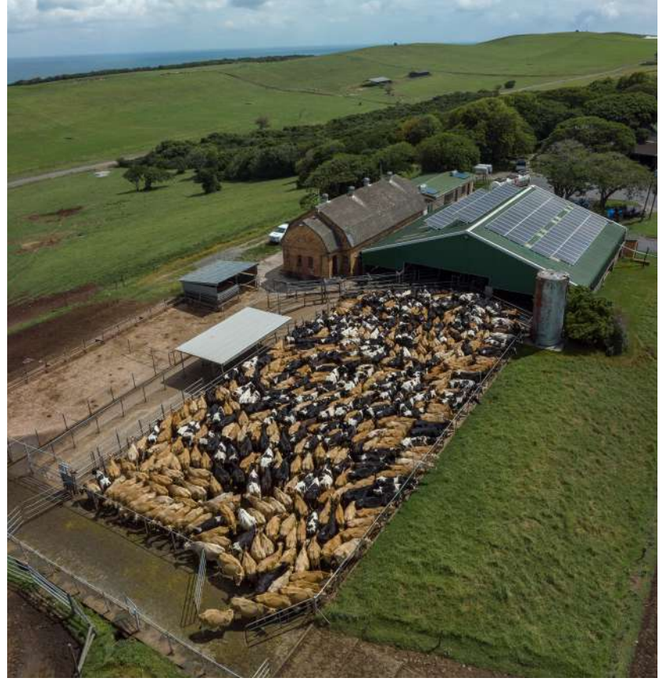


AGRIFOOD SYSTEMS TRANSFORMATION IS FUNDAMENTAL TO ACHIEVING

Paris Climate Goals

With devastating climate emergencies—from heat waves and wildfires to chronic droughts and famine—becoming the modern norm, we must acknowledge and understand the inextricable and bidirectional link between our agrifood systems and climate change.

Agrifood Systems as a Driver of Climate Change

Roughly 38% of the globe's land surface is used for crops or livestock,[1] and about half of the ocean's surface area is actively fished.[2] It comes as no surprise that our global agrifood systems' impact on the natural environment is monumental.

Agrifood systems are responsible for about a third of total global greenhouse gas (GHG) emissions we are contending with today. Emissions come directly from food production activities and, indirectly from ecosystem changes that affect emissions, such as through land and ocean ecosystem alterations and consumption behaviors. The largest emission sources are livestock, crops, and land use changes from soil cultivation. Methane, primarily from livestock and rice cultivation,[3] is expected to cause nearly half of the projected temperature rise due to new GHG emissions over the next two decades. Other major contributors to GHG emissions include food loss, waste, and disposal (8-10% of emissions)[4] and food transportation (19% of emissions—nearly half of which comes from high-income countries).[5] The consumers' role also cannot be ignored: global consumption patterns alone could add nearly 1°C to warming by 2100.[6]

Agrifood systems are also a major global user and polluter of fresh water sources. Irrigated agriculture accounts for 70% of all water uses worldwide.[7] Excessive groundwater withdrawals can cause saltwater intrusion, making croplands unusable, or subsidence that destabilizes homes and roads. Agriculture is a major source of polluted runoff, causing 78% of global ocean and freshwater eutrophication, which exacerbates climate change.[8]

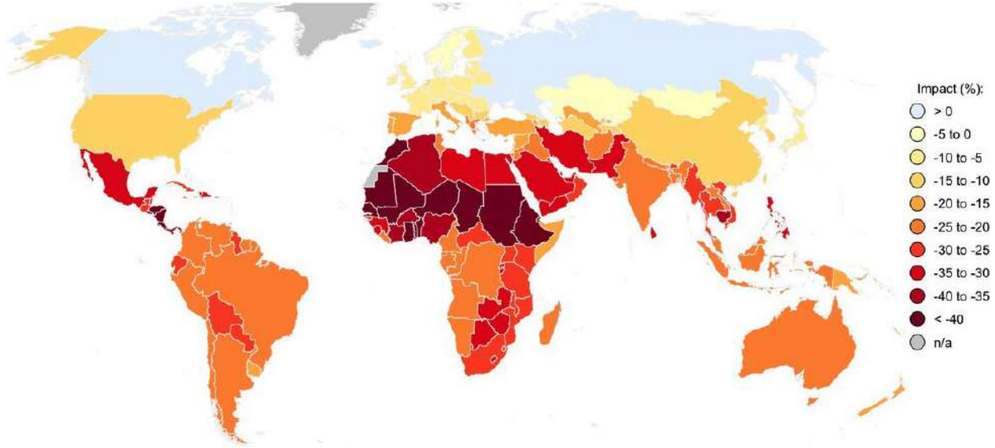
Finally, our global agrifood systems are the primary driver of biodiversity loss, with agriculture alone threatening 86% of the species at risk of extinction. Biodiversity gives our planet the evolutionary "deep bench" of resilience it needs to bounce back from shocks and crises, but the rate of species loss today is higher than the average has been over the last 10 million years.[9]

The Other Side of the Coin: Climate Change Impacts on Agrifood Systems

Our changing climate also poses challenges to many aspects of the agrifood systems, including: declining agriculture, livestock, and aquaculture productivity and viability; water-driven instability; the spread of infectious diseases; and supply chain disruptions to global trade.

Many of the core production areas of staple crops are projected to experience yield losses greater than 5%, up to 34% in resource-poor regions where malnutrition is more prevalent.[10] Higher temperatures and changing rainfall patterns make marginal lands used for livestock grazing less viable or even uninhabitable for animals. Warming waters contribute to reduced productivity for some fish species and their migration to deeper, colder waters. Ocean acidification and sea level rise threaten aquaculture mollusk production.

Reductions in Productivity Growth in Agriculture as a Result of Climate Change



Source: Ortiz-Bobea, Anthropogenic climate change has slowed global agricultural productivity growth[10]

Food production systems are exceptionally vulnerable to drought and declining groundwater supplies. More frequent and severe droughts impact agricultural production, while rising temperatures translate into increased crop, livestock, and human health water demands. Too much water can be equally devastating for crop production, with extreme weather and flooding capable of destroying millions of acres of crop harvest.

Climate change can also contribute to the accelerated spread of animal, animal-to-human, and crop diseases and infestations, and the resulting supply chain disruptions.[11] COVID-19 gave us a vivid illustration of what ensues.

The linkages across the climate-food nexus are numerous and diverse—but fortunately, so are the solutions. A just and sustainable agrifood systems transformation for planetary health requires both bold mitigation and innovative adaptation. We must mitigate our food production, processing, distribution, and consumption patterns' carbon footprint, water and land usage, and their toll on natural habitat and biodiversity. At the same time, we must sufficiently adapt our agrifood systems to the growing challenges that climate change presents, and its implications for farmers' and fishers' livelihoods, food security and nutrition, and the health and wellbeing of all. Many of these solutions are already evident and in successful use—but we need stronger political will, more aggressive and diverse financing, and greater technical and human capacity to implement these solutions more broadly to bring our agrifood systems within planetary boundaries.

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AGRIFOOD SYSTEMS TRANSFORMATION IS FUNDAMENTAL

To Achieving Equitable Livelihoods Across the Agrifood Value Chain

Across smallholder farmers, post-harvest processors, and sellers in the marketplace, agrifood systems are a vital source of subsistence, income, and livelihoods. With 1.23 billion people directly employed by agrifood systems, nearly half of the global population depends and relies on agrifood systems for their livelihoods.[1] Yet, tremendous poverty, vulnerability, and inequity exist for those working within them.

Poverty and Income

Globally, two-thirds of individuals living in extreme poverty (<US$ 1.90 a day purchasing power parity [PPP] 2011) are agricultural workers and their dependents.[2] Food producers rely on nature-based resources for their livelihoods, making them particularly vulnerable to shocks and stresses affecting the land, water, forests, and fisheries they maintain.

Too often, the post-farmgate workforce—including workers in slaughterhouses, processing facilities, food warehouses, grocery stores, and food service—experience suboptimal working conditions, even in high-income countries. This includes lack of benefits, reliance on public support systems, poor quality of life, lack of upward mobility, improper safety training, unsafe working conditions, and gender- and race-based discrimination.[3,4] Global analyses suggest that only 30 of the 350 major global food companies are taking action to support living wages in their direct operations or supply chains—with only two companies providing evidence of achieving a living wage salary for workers across their operations.[5]

Further, estimates suggest that producers earn a dismal fraction of the total money spent by consumers on food: on average, 27% of consumer spending on foods consumed at home is paid to farmers—with the remainder going to the post-farmgate value chain.[6] In too many places, profit is inequitably being distributed across the value chain.

Vulnerability Within Agrifood Systems

Layered onto the stark income and poverty realities, agrifood systems workforces experience further vulnerability and inequity, particularly smallholders, wage earners, women, youth, disabled, the elderly, minority populations, low income communities, and Indigenous Peoples.[7] For example, disruptive climate shocks to natural resources and chronic environmental degradation and biodiversity loss are disproportionately experienced by agricultural producers. As a result, they are at higher risk of food insecurity and deepening poverty than the population as a whole. Technological innovations, from agricultural inputs to food service applications, have inequitably favored agrifood systems in high-income countries and individuals of wealthier sub populations; while infrastructure deficits (roads, cold chain, etc.) limit stable and affordable access to nutritious food and exacerbate food loss and waste issues in low-income countries.[7]

Conflict disproportionality harms those employed and dependent on agrifood systems. For example, evidence suggests that eight months into the Russia-Ukraine War, agricultural households in Ukraine were increasingly and disproportionately impacted by the conflict, including disruption to their supply chains, price volatility, increased production costs, reduction or stoppage of agricultural production (1 in 4 households), reduced income, and increased total expenditures on food.[8] Political systems that regulate food safety and product standards also oftentimes disproportionality disempower smallholders with fewer resources and less training to adhere to standards.[9] Demographic factors such as gender and education can be barriers to equitable livelihoods, as women, minority, and Indigenous Peoples disproportionately lack mobility and access to finance and business mentors, have lower literacy rates, and experience discriminatory cultural and gender norms.[7] For example, while a quarter of employed women work in agriculture, particularly in low-income and lower-middle-income countries, they are more often relegated to informal, low-paid, low-skilled, labor-intensive, and vulnerable jobs.[10] Together, these vulnerabilities impede agrifood systems workforces' stable and equitable livelihoods—and require significant financing and transformational policy agendas to resolve.

Ultimately, an agrifood systems transformation is required that upholds livelihoods, delivers fair wages, and ensures empowerment and resilience of stakeholders across the value chain.

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Reimagining Financing and Valuing Diverse Returns for Agrifood Systems Transformation

Ensuring an affordable, nature-positive, and healthy diet for a growing population, adapting to climate's impacts on our agrifood systems, and securing equitable livelihoods for the agrifood workforce will not be possible without adequate capital. However, agrifood systems transformation is woefully underfunded. In 2019–20, agrifood received only 4.3% of total global climate finance, and only 1 in 10 total venture capital dollars in food tech went into companies focused on climate-resilient solutions (with limited evidence on financing for other impact goals such as nutrition).[1] Funding is primarily from public finance, with 85% of total project-level climate finance from government and development financing institutions.[1] Accelerated private finance is urgently required to complement this public funding, but investing in agrifood business has historically been deemed too risky or incompatible with the market returns required by most finance-first investors. We challenge this paradigm by advocating for:

- **A broadened scope of financing mechanisms**
- **An expanded definition of returns—balancing a quadruple bottom line of Profit, People, Planet, and Prosperity.**

A Broader Scope of Financing Mechanisms

Current financing for agrifood systems transformation is grossly insufficient, and what is available is often incompatible and inefficient. Fit-for-purpose capital must be deployed, making the appropriate match between the investors' risk appetite, ticket size, and geographical requirements, and the solution's risk profile (business or operating model, location in the value chain, leadership team, greater macro-ecosystem within which it operates, etc.).

The Blended Finance Taskforce's "Better Finance, Better Food" case study catalogue describes seven core financing archetypes that reduce financing and resource inefficiencies, capture value for nature, and leverage public and philanthropic funds to accelerate greater private finance for scale,[2] summarized in the adapted figure on page 15. In addition, it showcases fifty financing innovations and business models that fall into these archetypes. These proofs of concept are a critical first step. Yet, there remains a paucity of financial return data to overcome the historical risk issues limiting private capital investment in agrifood systems. We must leverage the learning from these case studies and build commercially-viable investment cases based on demonstrated success in order to drive away from a circuitous conversation and instead move towards mobilizing a broader group of private finance actors and increasing capital flows.

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Business Model and Financing Archetypes can Address Key Inefficiencies of Today's System

From an Old System...		...to a New System...	...Through Seven Financing Archetypes
Short-Term Inventives	→	Long-Term Growth	**Impact Investing/Blended Finance Funds** refer to investments made with the intention of generating a measurable social and/or environmental impact alongside a financial return. Investments can be "blended" with development capital, to mitigate particular risks and mobilise commercial capital.
High Capex & Opex	→	Low Opex	**Shared Services/Fintech** are solutions to increase project viability by turning fixed costs into variable ones and improving access to capital by enabling digital payments and creating digital footprints to build credit profiles and use as collateral.
High-Risk Counterparts	→	New Generation Entrepreneurs	**Supply Chain Innovations** are new contractual arrangements between supply chain actors that incentivize sustainability performance and/or ensure long term offtake, allowing sustainable ventures to scale.
Externality-Generating Assets	→	Regenerative Assets	**Sustainability-Linked Debt** with pricing contingent on the achievement of sustainability targets by the borrower, or capital market instruments issued by governments, development banks, companies to finance green projects only. These include sustainability-linked loans and bonds; green, blue, sustainability and transition bonds; green ETFs.
Exposed to Climate-Related Risks	→	Management of Climate-Related Risks	**Nature-Linked Insurance** includes innovative mechanisms such as parametric and microinsurance that are either based on the improved adaptation/resilience driven by natural assets or de-risk investment by protecting against climate risk.
No Revenue Streams from Nature	→	Valuing Nature	**Paying for Nature** include payments to incentivise the protection and management of nature by attaching a value to the services it provides like climate change mitigation, oxygen, flood management, or temperature regulation.
Limited Investable Pipeline	→	Robust Investable Pipeline	**Incubators and Accelerators** inject capital into early-stage/pilot projects with the aim of developing a robust and investable pipeline. Their services include technical assistance, project preparation, fundraising, advisory, and seed funding.

Exhibit adapted with permission from Blended Finance Taskforce

Redefining Returns

Clearly, financial return will be a priority for most mainstream investors. However, the private finance community must also acknowledge that the type and amount of returns possible for different solutions is highly variable. Investing in a smallholder cooperative farm in a conflict-ridden, low-income context has a drastically different risk and return profile than a sustainably packaged, 'better-for-you' prebiotic soda company in a stable, high-income country context.

Both require capital, both can yield commercial returns.

Deploying diverse, fit-for-purpose financing models to match the risk profiles of solutions must also take into consideration the types of financial, societal, and environmental gains delivered by the solution. Doing so requires quantifying and valuing the economic returns to society beyond financial returns to shareholders. The Food and Land Use Coalition (FOLU) estimates that a reform agenda for agrifood systems, comprised of 10 critical transitions for People, Planet, and Prosperity, would translate to an estimated US$ 5.7 trillion annually in economic gains for society as well as US$ 4.5 trillion a year by 2030 in business opportunity.[3] For adequate capital to flow into these business opportunities, investors must understand and value these long-term, societal impact gains alongside financial profit. Ultimately, recognizing that addressing today's environment, health, and detrimental societal costs of agrifood systems represent tomorrow's new market opportunities and cost savings will be transformational for businesses and society.

A Diversity of Solutions for Agrifood Systems Transformation

Embracing Diversity to Tackle Complexity

The preceding pages painted a harrowing picture of the state of our global agrifood systems. Clearly, the agrifood systems crisis we face is complex.

THE AGRIFOOD SYSTEMS CRISIS IS:

- **MULTI-DIMENSIONAL** The challenges faced and impacts felt span several dimensions: food insecurity, malnutrition, and diet-related chronic diseases; global warming, biodiversity and habitat loss, and declining natural resources; and poverty, unfair labor practices, and inequity.
- **INEQUITABLE** While every person on the planet experiences the global food crisis in some shape or form, the impacts are not evenly experienced—with a majority of people's livelihoods, health, and well-being persistently threatened and only a minority unscathed. Most often, those hardest hit are the most marginalized in society: women and children, the elderly, low income, socially isolated, smallholders, wage earners, racial or ethnic minority, and Indigenous Peoples.
- **UNDERFUNDED** Investment to fix agrifood systems is woefully insufficient, and is sourced mostly from public rather than private financing resources. Yet, food and agriculture represent a multi-trillion-dollar private industry, with enormous new business opportunities across developed and developing markets and cost savings from advancing human and planetary health.
- **INTERCONNECTED** A blockage or disruption in the agrifood system can send resounding ripple effects across the value chain. Each cog in the system is interrelated (and potentially dependent), such that a shock or stress in one place often leads to serious upstream and downstream consequences.
- **GLOBALIZED** The global agrifood systems are supported by transparent, rules-based, and efficient trade among economies. Globalization supports efforts to achieve caloric sufficiency, but has also contributed to specialized and simplified agrifood systems that fail to adequately enhance environmental efficiency, optimize land use, or ensure dietary diversity. While globalization has allowed for increased consumer choice in some communities, monoculture staple crops dominate the supply chain and crowd out local varieties in most cases. Ultimately, a greater balance must be struck between efforts to achieve efficient trade and meet caloric needs with efforts to prioritize dietary diversity and sustainability, preserve Indigenous practices and knowledge, uphold food sovereignty, and ensure local livelihoods.
- **VOLATILE** Repercussions of chronic agrifood systems dysfunction are continuously experienced around the world, while acute shocks and stresses augment these chronic problems and further challenge the resilience of communities.
- **UNPREDICTABLE** When crises unfold and their ripple effects are felt across agrifood systems, new and seemingly unforeseen challenges for health, climate, and livelihoods begin to unfold.

A complex crisis like this cannot and will not be solved by a singular solution. Instead, we must embrace that a diversity of solutions, working on different challenges, geographic scales, and time horizons, will be essential to sustainably transform agrifood systems for People, Planet, and Prosperity. Embracing a myriad of solutions requires confronting each of the attributes of the global agrifood systems crisis. The corollary of each of these attributes is tremendous opportunity to tackle these challenges head on. Below are central tenets for assembling a diverse solution set.

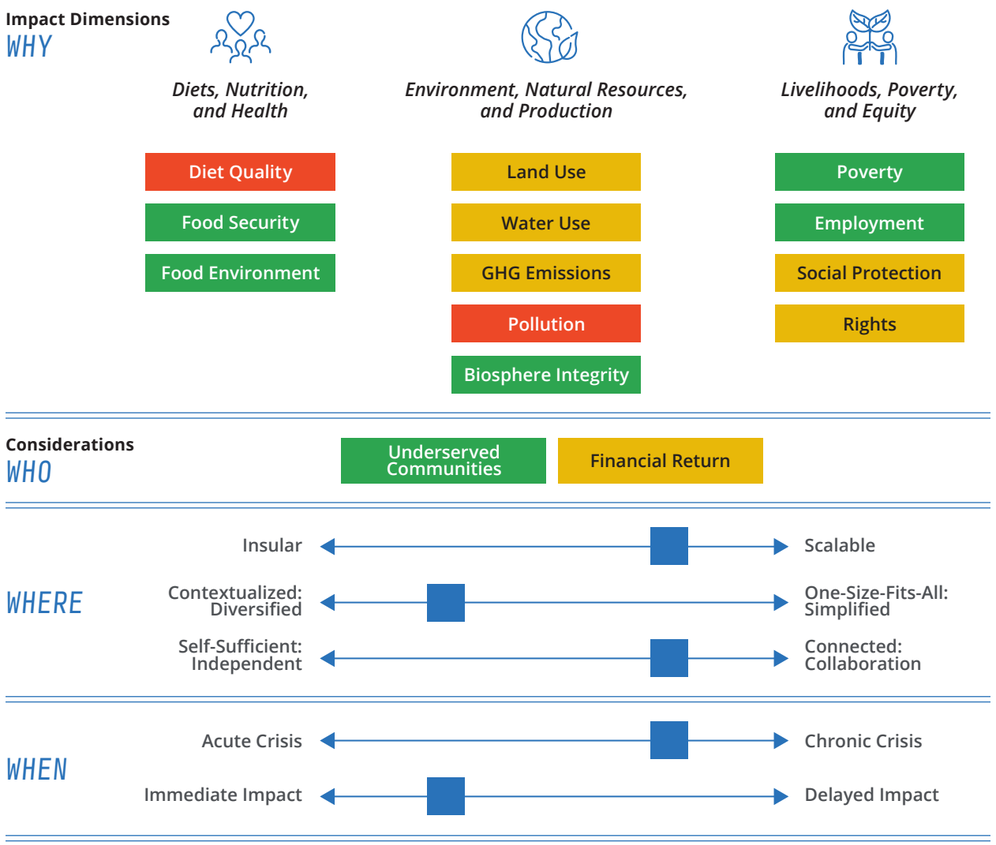
A DIVERSE SOLUTION SET:

- **SPANS DIMENSIONS** Solutions that tackle the interconnected root causes of multiple human and planetary health challenges (i.e., double and triple duty actions) should be championed as the most efficient way forward.
- **QUELLS INEQUITIES** Solutions that address the needs of vulnerable populations will help to restore or maintain socioeconomic stability, promote productivity, and ensure community resilience.
- **ATTRACTS DIVERSE CAPITAL** Solutions that leverage fit-for-purpose financial mechanisms, crowding in private investment through innovative, blended financing models, will be able to meet capital needs to function effectively and scale. Acknowledging that solutions from across agrifood systems value chains will have unique capital needs and yield diverse financial, societal, and environmental returns requires embracing broader definitions of financing options and returns possibilities. Making these changes will be critical to garner the appropriate and sufficient capital stack for each solution.
- **PROMOTES VALUE CHAIN CONNECTIVITY** Solutions that create interconnectivity, build transparency and collaboration across stakeholders, and promote regular communication through the value chain will nurture greater efficiency and prevent the cascading of problems to other actors.
- **BALANCES CONTEXTUALIZATION AND GLOBALIZATION** Solutions that are tailored to the geographic context, including the socioeconomic, cultural, and political realities faced in communities, will ensure relevance, adoption, and impact. At the same time, solutions that can be generalized for global applicability and scaled to maximize their efficiency and reach across diverse contexts will have greater global impact. Both are required.
- **OPERATES ACROSS TIME SCALES** Solutions must include those that address immediate, acute crises, while also critically moving forward on those that tackle chronic challenges of our agrifood systems.
- **DELIVERS FOR TOMORROW** Solutions that deliver immediate results for today's public health, climate, and poverty crises must be complemented by the science, innovation, and technology that can deliver future impact, restructuring, and long-term resilience of our agrifood systems when brought to scale.

Because no single solution can tackle all these attributes, a diverse toolbox of strategies can aspire to these tenets across geographic contexts and across the value chain to catalyze a just transformation of agrifood systems for People, Planet, and Prosperity.

The Impact Fingerprint

The Impact Fingerprint below provides a "bird's eye view" of the extent to which a given agrifood systems solution uniquely achieves these central tenets for addressing agrifood systems crisis. Ultimately, no one solution will be able to check every box. The Impact Fingerprint is an investor or funder's entry point for identifying, beginning to understand, and evaluating the diverse positive, negative, and neutral impacts a given solution has on equitable human and planetary health returns. It also helps them to reflect on and balance stakeholder, spatial, and temporal considerations. It is designed to enable investors and funders to better understand the nuance that exists when evaluating the trade-offs between human health, climate, and livehood impacts (the WHY); as well as considerations across stakeholders (the WHO: equity across the value chain and financial returns), geographic scales (the WHERE: scaling potential, contextualization, and value chain connectivity), and temporal scales (the WHEN: acute vs. chronic solutions and immediate vs. delayed impacts).



Color coding conveys the estimated net impact (green: positive; yellow: neutral; red: negative) for each impact dimension (the WHYs). Impact dimensions derived from Food Systems Countdown Initiative (FSCI) indicator architecture (see further details in Data Empowers Change section).[1] Color coding is similarly used to indicate whether the solution addresses the needs of communities that are underserved and provides financial returns (green: yes; yellow: neutral/unknown; red: no) (the WHOs). For the remaining geographic and temporal scale considerations (the WHERE, the WHEN), sliding scales are provided to convey where on each spectrum the solution falls.

From policymakers prioritizing local funding allocation to investors building out a robust food and agriculture portfolio, decisionmakers should aim to have positive impact across the three major impact dimensions (the WHYs) and strike a balance between the major considerations (the WHO, WHERE, and WHEN) when building the ideal set of solutions.

To reduce inherent subjectivity in this qualitative judgement, future iterations of the Impact Fingerprint will incorporate robust, quantitative data based on validated solution-level metrics, selected to best capture each impact indicator. Identifying, understanding, and quantitatively measuring these trade-offs in real-time (or through best possible modeling techniques) will allow investors and funders to both make more informed decisions and be more transparent and accountable for their human and planetary health impacts.

In the pages that follow, we discuss the complex trade-offs across impact dimensions, and what must be further considered when evaluating agrifood systems solutions. We elaborate on how metrics based on readily available data can empower decisionmakers to make informed choices in real-time.

Why: Addressing the Multiple Dimensions of our Agrifood Systems Crisis

One of the fundamental reasons our global agrifood systems crisis is complex is because it is multi-dimensional. As discussed in the preceding pages, the three major dimensions of our agrifood systems crisis, and thus the important targets of any corresponding solution set, are:

Agrifood systems advocates oftentimes rally around the separate goals of improving human health, quelling climate change, or ensuring equitable livelihoods and fair wages. Consequently, proposed solutions to address these issues often seem incongruent or unbalanced. Thus, efforts to drive agrifood systems changes to address each impact dimension have historically been siloed and separated, funded by different capital, and driven by different champions.[2]

The interconnected root causes must be embraced and leveraged to drive agrifood systems transformation by:

- Prioritizing solutions that address root causes through double and triple duty actions
- Emphasizing solutions that carefully consider the three major impact dimensions of the crisis
- Balancing solutions across scales of time, location, and populations
- Identifying, measuring, acknowledging, and grappling with the potential trade-offs between these impact dimensions for each solution

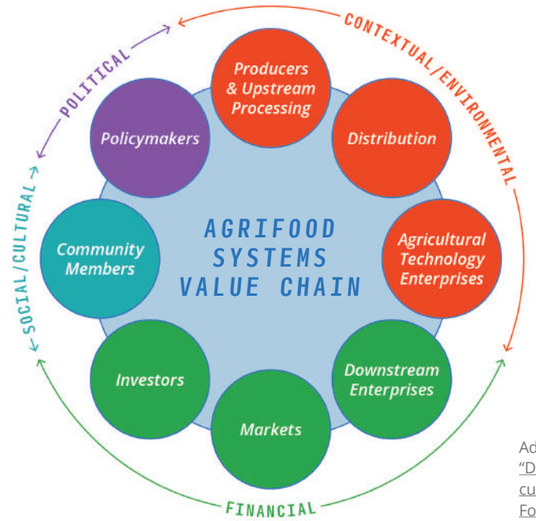
TO BRING THE CONCEPT OF TRADE-OFFS TO LIFE, CONSIDER THE PRODUCTION AND CONSUMPTION OF PROCESSED MEATS:

Research indicates excess consumption of processed meat is associated with increased risk of type 2 diabetes, cardiovascular disease, and certain types of cancers (PEOPLE).[3,4] Meat production is also resource-intensive (carbon, water, and land—to name a few),[5] and a major driver of our agrifood systems burden on planetary health (PLANET). Slaughterhouses and meatpacking facilities consistently are viewed as the most hazardous, unsafe working environments (PROSPERITY).[6,7] Eliminating processed meats from our diets thus seems like "low-hanging fruit" to deliver for People, Planet, and Prosperity. And yet, processed meats have their place in many global diets. In some geographic contexts, they are a crucial part of culture. In other contexts, processed meats are an affordable and convenient option when full dinner plates for a family are not always guaranteed. In places where stunting and micronutrient deficiency are prevalent, processed meats can be a viable, affordable, shelf-stable option for providing the essential nutrients required for these populations (PEOPLE) and can contribute to reducing food waste (PLANET). Thus, a seemingly "low-hanging fruit" solution for our shared goals for People, Planet, and Prosperity is more nuanced than it initially seems.

The complexity of the agrifood systems crisis means that for every decision or action there are trade-offs across its multiple dimensions. In addition to these trade-offs, we must also further consider the complex global stakeholders involved (the WHO); whether the solution is contextualized, scalable, or enhancing value chain connectivity (the WHERE); and the time scales on which the solution operate and the impacts are realized (the WHEN). These considerations, which round out the central tenets of assembling the diversity of solutions, are expanded upon in the pages that follow.

Who: *Meeting the Needs of Diverse Global Stakeholders*

"Who" encompasses the entire range of actors and their interlinked activities across agrifood systems value chains.[8] Each stakeholder can change the agrifood systems and/or feel the impacts of their crisis. This includes:



Adapted from Cornell's "Discovering the Food System" curriculum and Connecticut Food System Alliance

Equity Considerations

Given the complex configuration of agrifood systems, no singular actor has sufficient power to steer the entire system.[9] However, some stakeholders have less capacity to influence change, experience harms more so than others, and are less resilient in the face of crisis.[10] This includes:

- **Smallholder Farmers and Fishers:** who disproportionately experience extreme poverty, food insecurity, and other associated vulnerabilities.[10,11]
- **Wage Workers and Other Post-Farmgate Workforce:** who experience unfair wages, unsafe working environments, and have limited resources, knowledge, or capacity to cope with crisis.[6,7,12]
- **Communities with Low Income:** who have limited decision-making capacity, whether due to personal financial constraints, access within their local food environment, discrimination and stigma, or limited resources to cope with inherent fluctuations and climate-related stresses.[13,14]
- **Pregnant Women and Young Children:** who are in many ways the gatekeepers to the future health and stability of populations. Ensuring their healthy diets can address the lifetime of health and well-being, mental development and work productivity, and economic stability.[14]
- **Indigenous Peoples:** who have experienced forced displacement, land grabbing, and loss of traditional practices and cultural identity as a result of exogenous practices, urbanization, and global food commodity markets.[15] Yet, they are gatekeepers and holders of tremendous local knowledge for sustainable land and biodiversity management as well as dietary diversity.[16]

The toolbox of solutions necessary for agrifood systems transformation must encompass the needs, unique traditional knowledge, and capacities of these stakeholders, ensuring their livelihoods, access to an affordable nutritious diet, and agency to cope and adapt in the face of climate and other escalating crises. In complex agrifood systems, a solution that is beneficial for one population's health, well-being, and livelihood may be extractive for another demographic.

As a moral imperative, understanding the benefits and harms for different stakeholders is crucial to ensuring that no one population is unduly harmed. From a socioeconomic perspective, addressing the needs of these stakeholders will stimulate economic growth, promote productivity, and ensure community resilience.

Financial Considerations

When we consider trade-offs for a given agrifood systems solution, financial return for investors and businesses cannot be ignored, but must be recognized and incorporated. The social imperative persists as a powerful narrative for influencing philanthropic and government stakeholders to drive funding for agrifood systems transformation. However, it would be naive to believe that this is sufficient for mobilizing mainstream, private finance. Instead, we must address the inherent risk of agrifood systems investment as well as the need for quantifiable financial return. Currently, agrifood businesses are not considered an investable asset class. How can we build capital stacks to attract investment of private capital? How can governments incentivize private capital investment flows to develop proof of concept regarding the opportunity for attractive returns? Acknowledging the role that financiers can and do play across agrifood systems will be critical to answering these questions, and as a result, will drive the capital flows required to achieve investment in the businesses necessary to create long-term resilience and sustainable transformation of agrifood systems.

Where: *Contextualization, Scalability, and Enhancing Value Chain Connectivity*

"Where" encompasses the local to global scale, considering solutions that embody both diversification and simplification, as well as the ability of solutions to be self-sufficient and independent vs. connected and collaborative. We highlight the role of interconnectivity as it pertains to communities as well as within the value chain.

Local vs. Global Debate

The myriad of solutions for agifood systems transformation must strike a crucial balance between specialized solutions that drive economies of scale with local diversification and contextualization, that may be more protective of the environment and able to meet specific communities' needs. For example, globalization offers the opportunity for local economies to specialize based on their local assets and improve efficiency.[17] Similarly, global- and national-level strategies could optimize animal-source food production by strategically utilizing grassland that otherwise could not be converted to arable land without significant adverse environmental outcomes.[17] These activities offer solutions to address globally-scaled issues. On the flip side, such specialization can contribute to soil degradation, reduced air and water quality, biodiversity losses, and simplified landscapes. It also reduces the growth of traditional crops in their natural habitats.[18,19] Contextualized solutions may be more insular, but can increase access to nutritious food by increasing availability of familiar, traditional, or Indigenous food options or by tailoring to specific dietary needs of local populations. Solutions that can be customized or tailored for specific communities' or populations' priority needs may be more relevant, adoptable, and sustainable.[20]

Interconnectivity

Across agrifood systems value chains, interconnectivity should be embraced, with solutions that increase collaboration and efficiency across value chain actors and operations.[21] Achieving value chain efficiency, resilience, and viability requires close coordination and communication across actors, as well as utilization of shared metrics and data collection.[21] Striving towards such connectivity within the value chain can pay out financially, can prevent shocks and stresses, and can help improve environmental efficiency.

At the community level, understanding the role of trade exemplifies the need for a balance of interconnectedness. Communities must be sufficiently self-reliant to maintain food sovereignty, but also adequately connected to ensure food security and livelihoods, particularly in the face of acute local crises.[22] Trade promotes food security by increasing availability, affordability, and stability of the food supply—offering a safeguard against local disturbances. However, if a community is overly reliant on imports, they could also be left unprepared and devastated in the face of disaster in the locales they primarily import from (e.g., war in Ukraine).[22] Conceptually, embracing a diversity of solutions encourages producers to connect to local markets, intermediate markets, as well as at the global scale.[22]

When: *Understanding the Time Scales on which Crises Operate and Solutions' Impacts are Realized*

"When" encompasses the time horizons on which a given challenge is operating (acute vs. chronic), as well as the time horizons on which the benefits or harms of a given solution are felt and realized (immediate vs. delayed).

Acute vs. Chronic Crisis

Amidst the current agrifood systems crisis, value chains are disrupted by acute natural crises (for example, floods, hurricanes, or wildfires), infectious disease outbreaks (COVID-19), and man-made conflicts (the Russia-Ukraine War) with drastic increases in food insecurity and wasting, water shortages and supply chain stoppages, and other immediate issues that challenge the basic maintenance, functioning, and survival of society.

In addition to responding to immediate needs and short-term shocks, functional agrifood systems must also address ongoing, chronic crises that are persistent and slow-building, such as diet-related chronic disease and global warming.

Sustainable agrifood systems must exemplify resilience to stressors in the short-term, but also evolve and grow sustainably in the long-term. Persistent monitoring of the current state of affairs is essential to identifying how today's needs evolve and to predicting what will be required for long-term prosperity and resilience.

Rapid Response vs. Long-Term Restructuring

We must champion a platform of innovations that can tackle challenges operating on different time horizons: those that can address the pressing public health, social, and environmental issues of today with immediate results given existing resources and capabilities, as well as those that when matured and scaled, can address the same issues with potentially greater, though delayed, impact.

We need innovations that consider the full range of human health, social welfare, and ecological interactions. The search for alternatives to animal meat exemplifies this innovation challenge: given the significant environmental and inconsistent human health impacts of animal-source foods, and the growing global demand for meat, we face great pressure to produce animal-free meat substitutes.[23] Innovators need to balance nutritional, animal welfare, cultural, equity, ecological, and energy factors, and produce substitutes that taste good and are affordable and safe. Many plant-based meat substitutes using legumes, grains, seaweed, fungi, and other sources of protein can be produced with resources that are available today. Animal-free technologies for cultivating meat and fish cells (to produce animal proteins without animals), which have the potential to complement the animal-source food sector, are also in the early production stages. Today they are cost-prohibitive, but are approved for sale in three countries (the U.S., Singapore and Israel) and are evolving rapidly. Apart from cost, the most significant challenges these solutions face include the energy and water usage demands of cell culturing and reliance on a 'culture medium' that is still largely derived from animals (although innovation is rapidly tackling this challenge). To adequately address long term challenges, the sector would benefit from more research into these complex issues to advance the most climate-friendly and healthy alternatives.

Data Empowers Change

In the context of the diversity of solutions for agrifood systems transformation, quantifying each solution's impact, both positive and negative, to our goals for People, Planet, and Prosperity provides crucial insights for stakeholders to make informed decisions, champion success, catalyze more progress, and ultimately drive real and measurable change. Whether by a donor agency, venture capitalist, or institutional investor, investments can be directed more intentionally and social, environmental, and health impacts can be measured and returned with the power of data.

Food Systems Countdown Initiative

An ambitious global monitoring architecture has been proposed by the Food Systems Countdown Initiative (FCSI) to track change, urge action, and hold leaders accountable at scale for guiding agrifood systems transformation.[24] In particular, the FSCI indicator architecture provides broad indicator domains and associated national-level indicators corresponding to the three impact dimensions of this report—People (diets, nutrition, and health), Planet (environment, natural resources, and production), and Prosperity (livelihoods, poverty, and equity). The indicator domains are provided in the figure below, and the associated national-level indicators that fall within each domain are provided in FSCI's publication.[1]

Diets, Nutrition, and Health

Food Environments

Food Security

Diet Quality

Environment, Natural Resources, and Production

Land Use

Greenhouse Gas Emissions

Water Use

Pollution

Biosphere Integrity

Livelihoods, Poverty, and Equity

Poverty and Income

Employment

Social Protection

Rights

Population-Level vs. Solution-Level Indicators

FSCI's three impact dimensions and indicator domains provide a helpful architecture for beginning to broadly understand and measure agrifood systems transformation. FSCI's national-level indicators are critical for tracking progress at a population-level. However, complementary solution-level indicators are also required to monitor and evaluate the impacts of specific solutions—from non-profit programming to commercially-viable business models.

Decisionmakers from farm to boardroom can benefit from understanding FSCI's framing for agrifood systems, as they similarly require rigorous and science-based metrics to inform their decision-making. However, the metrics required for continuous monitoring and evaluation of solutions must be localized, material, real-time, and based on available data to objectively weigh the trade-offs that exist for solutions under consideration.

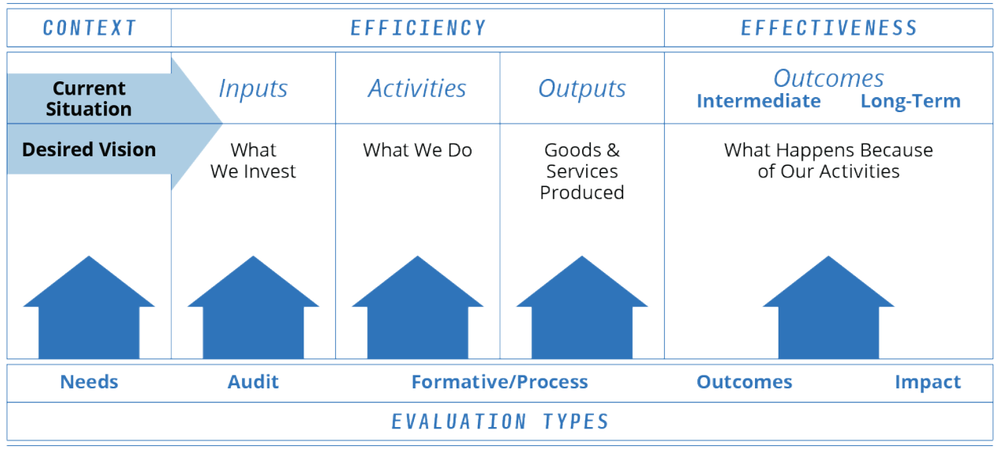
In the table below, we have provided the corresponding population-level and solution-level indicators for three illustrative FSCI indicator domains.

Food Systems Countdown Impact Dimension	Population-Level Indicator[1]	Solution-Level Indicator[25,26]
Diets, Nutrition, and Health: *Food Environment*	Cost of a healthy diet (current PPP [purchasing power parity] US$/person/day) Availability of fruits and vegetables (grams/capita/day) Prevalence of type 2 diabetes and obesity (# cases)	Sales-weighted measure of healthfulness of portfolio products, using a validated nutrient profiling system Percentage of sales stratified by healthfulness of products and income measure (%)
Environment, Natural Resources, and Production: *Water Usage*	Agricultural water withdrawal as % of total renewable water resources (% total renewable)	Total water withdrawn (cubic meters) Total water consumed, percentage of each in regions with High or Extremely High Baseline Water Stress (%)
Livelihoods, Poverty, and Equity: *Employment*	Unemployment, rural (% working age population) Underemployment rate, rural (% working age population)	Voluntary and involuntary turnover rate of employees Average hourly wage, by region (US$) Percentage of employees earning minimum wage, by region (%)

FSCI's national-level indicators assess the indicator domains at a population-level. This type of data comes from nationally representative surveys as the result of significant, streamlined government efforts to track country-level progress. Such data is monitored with a standard cadence (annually among only the most proactive nations) and is critical for policymakers to take stock of progress and make informed policy decisions. In contrast, the solution-level indicators, are meant to be real-time, regularly monitored metrics of a program or business output. Illustrative solution-level metrics provided in the table are sourced from environmental, social, and governance (ESG) global reporting standards and associated literature. Increasingly, businesses and non-profit organizations are held accountable to measure such metrics, report out on a quarterly basis to their executive boards and the public, or have systems to track and flag underperformance. Thus, the data collection responsibility, cadence of tracking, and interpretation of information between population-level vs. solution-level can vary substantially.

To elucidate the similarities and differences in the types of metrics required for population-level tracking vs. solution-level monitoring and evaluation, we walk through examples for each impact dimension.

A results chain (see figure below, adapted from Allen et al. 2017[29]) is a visual aid that links the short- to long-term via inputs, activities, outputs, outcomes, and impacts, and is helpful for identifying critical metrics and data sources for evaluating a solution. For most solutions, we can measure intermediate outcomes in real-time, but require modeling techniques or rigorous experimental study design to be able to attribute the solution's activities to the long-term outcomes and impacts in the community.



Adapted from Allen et al. 2017

Diets, Nutrition, and Health

FSCI's national-level indicators focus on population-level metrics like "cost of a healthy diet," prevalence of diabetes, NCD-Risk score, and percentage of population who cannot afford a healthy diet.[1] While these are helpful metrics to track national progress towards global goals, they are less relevant in evaluating solutions for which we cannot directly attribute change or progress. Attribution of nutrition and health outcomes to any given solution requires either major assumptions or costly and time-intensive experimental study designs. "Cost of a healthy diet," for example, is the result of many complex trade, political, economic, environmental, and social factors affecting price and availability of nutritious foods in different country contexts. To develop solution-level indicators, we must instead look at measuring earlier in a given solution's "results chain" (see page 26), including direct outputs or intermediate outcomes that are sensitive to short-term changes and more practical to measure. The scientific literature supports the use of intermediate metrics to evaluate direct intervention outcomes as a proxy for behavior changes required for long-term nutrition impacts (e.g., retail sales data to reflect changes in diet quality as opposed to long-term impacts such as changes in types 2 diabetes prevalence).[27,28,29]

Environment, Natural Resources, and Production

Metrics at the population- and solution-level are much more congruent for planetary health indicators. For example, the metrics for "water withdrawn"—whether as an absolute value in cubic meters or as a percentage of total renewable resources—are the same at both levels. What differs at a population- vs. solution-level is the scale, units required, and comparisons drawn. We observe a similar situation with GHG emissions. While the units, scale, and data provided will vary drastically if we are assessing at population-level vs. solution-level, the metric remains the same. Direct environmental impacts can be quantified and attributed to a given solution using advanced modeling methodologies such as life cycle assessments (LCA). By thoroughly inventorying the energy and materials required across the agrifood systems value chains for a product or solution, LCA allows researchers to calculate the corresponding total resource usage and emissions as an indication of the cumulative impacts of that given product or solution.[30]

Livelihoods, Equity, and Poverty

Indicators for poverty and income also vary significantly at the population- vs. solution-level. While FSCI suggests "unemployment rates, rural" as a national-level indicator of livelihoods,[1] this indicator has no direct relevance when evaluating specific solutions. Businesses tracking their social impact, workers' rights, and fair labor practices instead require immediate, real-time metrics associated directly with their operations, including: turnover rate (voluntary or involuntary); hourly wage, stratified by region; and percentage of employees earning minimum wage (%).[26] Such solution-level metrics feed into national poverty and income indicators. However, assigning attribution of national unemployment rates to any given solution would be flawed, as unemployment is a result of complex social, political, economic, and environmental factors.

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What is next?

We propose a major research agenda for building out the toolkit of comprehensive, robust, and real-time metrics for measuring and managing the impact of solutions for agrifood systems transformation across diets, nutrition, and health; environment, natural resources, and production; and livelihoods, equity, and poverty. Building off FCSI's indicator architecture, we must advance parallel efforts to their initiative's population-level tracking work for monitoring and evaluating at the solution-level.

This will require gathering feedback and building consensus across existing responsible investing and ESG disclosure standard setters (such as the International Sustainability Standards Board [ISSB] and the Global Reporting Initiative [GRI]), the scientific community, and public and private investors who will ultimately utilize such metrics across their funding or asset lifecycle. Collaboration with the research community is required to accelerate expansion of LCA capabilities for other critical impact dimensions—including diets, nutrition, and health; livelihoods, poverty, and equity; and positive impacts of environmental impacts such as enhancing soil quality or landscape provision. Finally, we must evaluate the financial materiality of each solution-level indicator, and its relevance for finance-first investors.

In the next chapter, we highlight three case studies of solutions from around the world that exemplify the central tenets of a diverse solution set for agrifood systems transformation. We apply the Impact Fingerprint for each solution to help in visualizing the complex trade-offs and considerations that exist.

BLACK SOLDIER FLY LARVAE

Developing a local, circular animal feed innovation to scale the commercial poultry supply chain and address chronic malnutrition among young children in Rwanda

FOOD SYSTEMS FOR THE FUTURE CASE STUDY

WHAT AGRIFOOD SYSTEMS CHALLENGE IS YOUR SOLUTION PRIMARILY FOCUSED ON?

Overall consumption of animal-source foods in Rwanda is suboptimal. For example, the average Rwandan only consumes 13 eggs a year, significantly below the 90 eggs recommended per year by the Food and Agriculture Organization (FAO).[1] Price is a limiting factor to animal-source food production and consumption. Animal feed accounts for approximately 70% of poultry production costs. In Rwanda, reliance on imported soybean feed results in drastic fluctuations in price and availability. Consumers' lack of knowledge about the importance of animal-source food consumption for child development also limits consumption.

WHAT ARE ITS HEALTH IMPLICATIONS?

90% of Rwandans cannot regularly afford a diverse and healthy diet. 33% of children under 6 years are stunted.[2] Stunting, or low height-for-age as a result of chronic malnutrition, detrimentally and irreversibly impacts mental and physical development, as well as future livelihood productivity and diet-related disease risk.[3]

WHAT ARE ITS CLIMATE IMPLICATIONS?

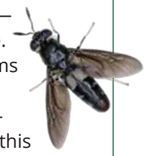
12% of Rwanda's GHGs come from waste, 78% of which is of organic origin.[4,5] The Rwandan government recognizes that urbanization and inefficiencies in the food supply chains across the country have resulted in increased food waste, and seeks to address this challenge through modernization of the waste management system including upcycling, recycling, and reuse.

WHAT ARE ITS EQUITABLE LIVELIHOODS IMPLICATIONS?

Reliance on imported feed for the poultry and fish supply chain detracts from local opportunities to catalyze economic development, creation of jobs, and reduction of poverty.

WHAT IS A COMPREHENSIVE AND INCLUSIVE VALUE CHAIN SOLUTION TO THIS CHALLENGE?

Black soldier fly larvae (BSFL) have a spectacular ability to convert organic waste into protein. The black soldier flies consume organic kitchen and market food waste as well as industrial food waste from processing plants—contributing to net reductions in food loss and waste. From every kilogram of organic waste, nearly 50 grams of protein are produced. An additional 100 grams of by-product can be used as efficient, natural nitrogen-phosphorus-potassium (NPK) biofertilizer. Together, this represents a tremendous new circular animal feed and biofertilizer source to revolutionize the poultry and fish feed and organic fertilizer supply chains in Rwanda.



WHAT IS AN EXAMPLE OF THIS SOLUTION IN ACTION?

In partnership with the Government of Rwanda and local agribusiness entrepreneurs, Food Systems for the Future, with technical assistance from Netherlands-based Protix, is coordinating the design and construction of an innovative BSFL automated production facility. The BSFL serves as a protein component replacement in animal feed for poultry and fish supply chains, and their production waste can be used as a bio-fertilizer on local vegetable, grain, and specialty crop farms to improve soil health fertility. BSFL is not only a reliable source of protein and essential minerals in animal feed: it also stabilizes and potentially lowers the price of traditional poultry feed, thereby increasing affordability and availability of animal-source protein, particularly eggs. BSFL offers a pathway to increase egg consumption, improve diet quality, and as a result, reduce stunting in Rwandan children. The scaling of BSFL production empowers the local (circular) economy by creating new local jobs during the facility construction and ongoing operation, while reducing dependence on animal feed imports.

BSFL *Impact Fingerprint*

Impact Dimensions
WHY

Diets, Nutrition, and Health	*Environment, Natural Resources, and Production*	*Livelihoods, Poverty, and Equity*
Diet Quality	Land Use	Poverty
Food Security	Water Use	Employment
Food Environment	GHG Emissions	Social Protection
	Pollution	Rights
	Biosphere Integrity	

Considerations
WHO

Underserved Communities | Financial Return

WHERE

Insular	Scalable
Contextualized: Diversified	One-Size-Fits-All: Simplified
Self-Sufficient: Independent	Connected: Collaboration

WHEN

Acute Crisis	Chronic Crisis
Immediate Impact	Delayed Impact

Color coding conveys the estimated net impact (green: positive; yellow: neutral; red: negative) for each impact dimension (the WHYs). Impact dimensions derived from Food Systems Countdown Initiative (FSCI) indicator architecture (see further details in Data Empowers Change section).[1] Color coding is similarly used to indicate whether the solution addresses the needs of communities that are underserved and provides financial returns (green: yes; yellow: neutral/unknown; red: no) (the WHOs). For the remaining geographic and temporal scale considerations (the WHERE, the WHEN), sliding scales are provided to convey where on each spectrum the solution falls.

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BSFL *Impact Analysis*

Diets, Nutrition, and Health of local communities are improved, particularly children experiencing chronic malnutrition and stunting (diet quality, food security). The retail environment in Kigali benefits from the infusion of more poultry and eggs at a cheaper price, thereby decreasing the cost of a healthy diet for local populations (food environment).

Environment, Natural Resources, and Production will mostly benefit relative to status quo poultry production in Rwanda. While animal-source foods like eggs and poultry are more environmentally intensive than plant-based alternatives, the solution's deliberate efforts to upcycle existing market and industrial food waste and utilize the BSFL by-products as biofertilizers is a marked improvement from existing poultry supply chain functioning. This solution requires utilizing local land for the BSFL facility, but at the global level, reduces reliance on imported soybeans which are more land-intensive, with parallel implications for biosphere integrity. Further evaluation is required to determine whether GHG emissions and water usage from the BSFL facility is greater, equal, or less than when relying on imported soybean for feed (production and transportation costs). Pollution impacts are net positive, reducing city food waste and loss and providing bio-rich fertilizers to horticulture and crop farms.

Livelihoods, Poverty, and Equity are improved and addressed for local communities. BSFL manufacturers enter as a novel stakeholder in the poultry supply chain. They will experience income and new employment with the ongoing operations of the BSFL production facility. These opportunities would not exist with continued reliance on imported animal feed. Poultry farmers may experience increased income and improved livelihoods, given the cost of poultry feed decreases by as much as 50%.

WHO

The solution directly addresses the health and nutritional needs of families and children with low income. The solution also has been specifically designed as a commercially viable and scalable business model. Investors in this solution financially benefit from the successful functioning of the BSFL facility by mass producing a novel animal feed and biofertilizer for producers nationwide. They also may benefit from potential carbon credits resulting from the upcycling of household, market, and industrial organic waste.

WHERE

Utilization of BSFL as animal feed is a solution that can be scaled across diverse global contexts. It is not specific to a geography, type of animal-source food production, or impact dimension, and thus a highly generalized solution. The circular nature of the solution embraces connectivity across value chain players in Rwanda—from feed producers, farmers, crop and horticulture farms, marketplaces, and waste facilities.

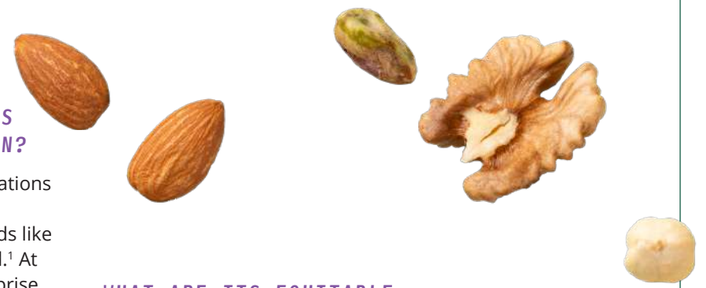
WHEN

This solution provides a systemic change to how poultry and fish are fed, how waste is disposed of from industrial and home sources, and how market prices of animal-source food are stabilized. BSFL represents a solution for long-term restructuring. Its impacts are delayed, particularly for health and nutrition outcomes, as it will take time for the functioning of the BSFL facility to impact poultry and egg prices and availabilty, and thereby food security and diet quality.

FOOD IS MEDICINE

Connecting regenerative agricultural production to consumers with pre-existing conditions to improve diet quality in the United States

TUFTS FOOD IS MEDICINE INSTITUTE CASE STUDY



WHAT AGRIFOOD SYSTEMS CHALLENGE IS YOUR SOLUTION PRIMARILY FOCUSED ON?

Americans do not meet the nutrition recommendations set forth by the Dietary Guidelines for Americans, consuming insufficient amounts of protective foods like fruits, vegetables, whole grains, nuts, and seafood.[1] At the same time, ultra-processed foods (UPFs) comprise the majority (58%) of total energy intake of U.S. children and adults.[2] The growing ubiquity of convenient, inexpensive, and heavily marketed UPFs has reshaped our globalized modern food supply, with significant implications for People, Planet, and Prosperity.

WHAT ARE ITS HEALTH IMPLICATIONS?

A growing body of research shows clear links of insufficient intakes of protective foods and excess intakes of UPF with increased risk of NCDs, health disparities, and adverse economic impacts.[3,4,5,6]

WHAT ARE ITS CLIMATE IMPLICATIONS?

The agrifood systems overlap of human health and planetary goals is nuanced and complex. Reducing industrially produced red meat is of primary importance for sustainability, yet would have minimal impacts on human health. In contrast, increasing the availability and consumption of fruits, vegetables, whole grains, nuts, and seafood would have major positive impacts on human health, but also, compared to commodity crops, potentially increase water use, land use, and food waste. The scaled production of commodity crops provides sufficient global calories but also threatens planetary health, with implications for agrobiodiversity loss, pollution of waterways and eutrophication, GHG emissions, land degradation, and packaging waste.[7,8]

WHAT ARE ITS EQUITABLE LIVELIHOODS IMPLICATIONS?

Recent evidence reveals major forced labor risks in the U.S. processed food supply—particularly for industrially processed animal products, processed fruits and vegetables, and discretionary factors such as sweeteners, beverages, and chocolate and cocoa—due to both multiple processing stages and higher labor intensity.[9]

WHAT IS A COMPREHENSIVE AND INCLUSIVE VALUE CHAIN SOLUTION TO THIS CHALLENGE?

Food is Medicine (FIM) strategies incorporate nutritionally-tailored food interventions into the healthcare system to support disease management (or less commonly, disease prevention or optimal health) as part of a patient's covered treatment plan. These programs include medically tailored meals and produce prescription programs, which each show tremendous promise for improving nutrition and health while also being highly cost-effective or even cost-saving.[10,11] With appropriate food sourcing, FIM programs can also help spur local economic development and climate-friendly farming practices by creating demand for regional, regeneratively produced foods. For example, the U.S. government funded Gus Schumacher Nutrition Incentive Program (GusNIP) provided US$ 41.6 million in produce prescription program incentives, while generating an estimated US$ 85.6 million in local economic impact from 2020-2021.[12]

WHAT IS AN EXAMPLE OF THIS SOLUTION IN ACTION?

Recipe4Health—a local FIM produce prescription program in Alameda County, California—creates healthcare demand for regenerative and organic produce that improves planetary health and simultaneously provides stable livelihoods for local Black, Indigenous, and People of Color (BIPOC) farmers and growers. Recipe4Health uses a nationally recognized, multi-sector model with three key intervention components:[13]

1. A "Food Farmacy" that prescribes patients a produce prescription, which is sourced and delivered directly to patients' doorsteps by Dig Deep Farms. Dig Deep Farms operates six farms with the goal of improving health and well-being by growing and distributing healthy food, creating jobs, and reducing recidivism through re-entry internships and jobs.[14] The Farm utilizes regenerative agriculture techniques including: reduced or eliminated tillage, cover cropping, crop rotation, composting, and reduced fossil-fuel-based inputs that lead to improved soil health, climate resilience, reduced GHG emissions, and restored natural ecosystems.[14]

2. A "Behavioral Pharmacy" that provides weekly individual and group health coaching for up to 12 weeks through the non-profit, Open Source Wellness, meeting the cultural and linguistic needs of the county's diverse community members; and

3. Food as Medicine training for health clinic staff to support implementation of the model.

Research has shown that national implementation of a produce prescription program, like Recipe4Health, could provide tremendous health and economic benefits.[15] However, future research on FIM interventions should include environmental and planetary health as well as livelihoods, poverty, and equity metrics, and look to Recipe4Health as an effective model of how to prioritize not only human health, but also social welfare and planetary health.

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FIM Impact Fingerprint

Impact Dimensions
WHY

Diets, Nutrition, and Health	*Environment, Natural Resources, and Production*	*Livelihoods, Poverty, and Equity*
Diet Quality	Land Use	Poverty
Food Security	Water Use	Employment
Food Environment	GHG Emissions	Social Protection
	Pollution	Rights
	Biosphere Integrity	

Considerations
WHO

Underserved Communities | Financial Return

WHERE

Insular	Scalable
Contextualized: Diversified	One-Size-Fits-All: Simplified
Self-Sufficient: Independent	Connected: Collaboration

WHEN

Acute Crisis	Chronic Crisis
Immediate Impact	Delayed Impact

Color coding conveys the estimated net impact (green: positive; yellow: neutral; red: negative) for each impact dimension (the WHYs). Impact dimensions derived from Food Systems Countdown Initiative (FSCI) indicator architecture (see further details in Data Empowers Change section).[1] Color coding is similarly used to indicate whether the solution addresses the needs of communities that are underserved and provides financial returns (green: yes; yellow: neutral/unknown; red: no) (the WHOs). For the remaining geographic and temporal scale considerations (the WHERE, the WHEN), sliding scales are provided to convey where on each spectrum the solution falls.

FIM Impact Analysis

Diets, Nutrition, and Health of local consumers, particularly those with diet-related chronic disease and food insecurity, benefit from the direct delivery of fresh fruits and vegetables (food security, diet quality). Scaling programs which provide fresh produce to large portions of the population could have long-term implications for the product portfolios of retail outlets (food environment). For instance, alternative produce prescription programs allow patients to receive free or purchase discounted produce from grocery stores and farmers markets, increasing demand for produce at retail outlets.

Environment, Natural Resources, and Production will benefit relative to scaling mainstream, non-regenerative production of fruits and vegetables. While Dig Deep Farms specifically integrates farming techniques that reduce GHG emissions and pollutants, its impacts on water, land usage, and biosphere integrity are not directly addressed, and thereby considered neutral. For example, it is unlikely that such a program would convert natural habitats and forests for agricultural use to scale and thus will have neutral effects on land use and biosphere integrity. The transportation/delivery of fresh produce for this solution could result in increased GHG emissions, but this interpretation is dependent on what the alternative mechanism for bringing this produce to market is (where, how, etc.), which has not been clearly defined.

Livelihoods, Poverty, and Equity of local community members will benefit, particularly individuals who were formerly incarcerated. Dig Deep Farm producers and distributors may experience increased income and employment, given increased demand for their produce from the produce prescription program.

WHO

This solution directly addresses the diet quality and food environment of community members who are underserved and food insecure with pre-existing diet-related health conditions. There is also potential societal cost savings in avoided recidivism and social welfare benefits as a result of successful reintegration of formerly incarcerated individuals into the program. The solution is not currently designed as a for-profit enterprise. To achieve positive financial returns for investors, such a program would require re-designing the solution into a commercially viable business model. This could involve a fee-for-service business that generates revenue by charging insurance payers for bringing fresh produce to their at-risk patient populations at scale.

WHERE

The solution provides produce from local farmers at Dig Deep Farms, as well as individual and group health coaching appropriate to the linguistic needs of the community. Given the proximity of the farm to the recipients and the linguistic adaptations, the program is well-tailored to the recipients' palates and potential to learn. Despite being highly contextualized, the program is scalable with broad applicability beyond this community as it is based on a nationally recognized, multi-sector model that could be implemented in many farming communities. The solution also promotes connectivity across the value chain, connecting Dig Deep Farm producers directly to produce prescription programs and the final consumer.

WHEN

This solution provides a fundamental change to how individuals access fresh fruits and vegetables, with long-term, positive implications for fruit and vegetable consumption. Thus, this program is not designed to address an acute crisis, but rather restructuring systems to increase fresh produce accessibility and address chronic low fruit and vegetable consumption among Americans. With minimal infrastructure required, the impacts of this program can be observed quite rapidly as soon as deliveries commence.

PREDICTION AND EARLY WARNING SYSTEMS

Using a novel prediction and early warning system to enable climate resilient fisheries for food and livelihoods in the Humboldt Current of South America

ENVIRONMENTAL DEFENSE FUND CASE STUDY

WHAT AGRIFOOD SYSTEMS CHALLENGE IS YOUR SOLUTION PRIMARILY FOCUSED ON?

The Humboldt Current region of South America, which extends from southern Chile to Ecuador, is the world's most productive fishing grounds. Thousands of coastal communities depend on fisheries as a vital source of food and essential nutrients, including omega-3 fats and calcium. The productivity of this ecosystem and the livelihoods of over 300,000 artisanal fishers are particularly vulnerable under the current El Niño phenomenon in the Pacific Ocean, intensified in frequency by GHG emissions and warming.[1] Without tools for being resilient to these changes, communities in Chile, Peru, and Ecuador will increasingly face food insecurity, nutrient deficiencies, and livelihood instability.

WHAT ARE ITS HEALTH IMPLICATIONS?

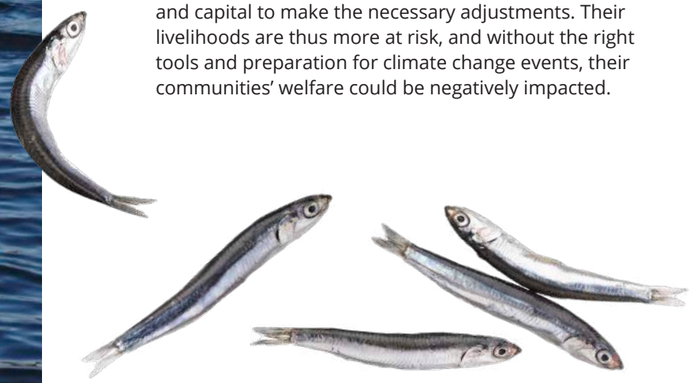
Peru already faces worrying levels of malnutrition: more than 30% of children between 6 months and 5 years have anemia, one of the highest prevalence rates in the Western Hemisphere.[2] Without climate-adaptive and well-managed fisheries these health implications could take a downward spiral.

WHAT ARE ITS CLIMATE IMPLICATIONS?

Climate change is causing increased environmental variability in the Humboldt Current Large Marine Ecosystem. As such, fisheries are seeing decreased productivity and biodiversity in some areas of the ocean, and extreme events that impact agrifood systems, such as hypoxic zones and harmful algal blooms (HAB) which can be toxic to humans.[3]

WHAT ARE ITS EQUITABLE LIVELIHOODS IMPLICATIONS?

As climate change takes hold, larger fishing companies and corporations will have the capital and the ability to adapt their business practices. However, small-scale fishing communities are disproportionately vulnerable to climate change impacts and often lack the tools and capital to make the necessary adjustments. Their livelihoods are thus more at risk, and without the right tools and preparation for climate change events, their communities' welfare could be negatively impacted.



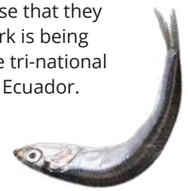
WHAT IS A COMPREHENSIVE AND INCLUSIVE VALUE CHAIN SOLUTION TO THIS CHALLENGE?

Prediction and early warning systems are a critical solution for ensuring small-scale fisheries are resilient to climate shocks and stresses and enabling delivery of their seafood to market. Such systems provide climate change indicators to fishers and policymakers so they can adjust their fishing practices and regulations to be adaptive to current oceanographic conditions, as well as receive early warnings for extreme events such as a strong El Niño phenomena and/or HABs. Prediction and early warning systems help to mitigate the impacts of climate change for both fishers' livelihoods and their food security.

WHAT IS AN EXAMPLE OF THIS SOLUTION IN ACTION?

The three countries of the Humboldt Current—Chile, Peru, and Ecuador—are collaborating on an ocean science tool that acts as a prediction and early warning system for climate resilient fisheries (SAPO). SAPO is taking lessons learned from the World Meteorological Organization's Climate Risk and Early Warning Systems initiative, which has developed a proven way to protect lives and livelihoods in the face of increasing climate hazards, responsible for 90% of all extreme events.[4] SAPO 2.0, which will be a user-friendly mobile app, will allow fishers to plan their fishing practices based on which species will be available given a dynamic and changing ocean, and will help fishers better negotiate with seafood buyers based on what types of seafood will be available for purchase. Together this helps to protect their livelihoods and improve knowledge throughout the supply chain as to which species are abundant based on current climatic conditions.

The recent El Niño alert that was released in March 2023 spurred increased investment by the Chilean government's Economic Development Agency (CORFO) to help small scale fishers by providing funding and technology to deploy oceanographic sensors for sea urchin, octopus, kelp, abalone (Chilean Loco), and other benthic fisheries. Monitoring temperature and ocean chemistry in real-time provides the artisanal fishers' organization with timely information in the event of a change that could cause a die-off of their main commercial species and those that they consume regularly for food. Similar work is being planned in Peru for late 2023 under the tri-national collaboration between Chile, Peru, and Ecuador.



SAPO *Impact Fingerprint*

Impact Dimensions
WHY

Diets, Nutrition, and Health	*Environment, Natural Resources, and Production*	*Livelihoods, Poverty, and Equity*
Diet Quality	Land Use	Poverty
Food Security	Water Use	Employment
Food Environment	GHG Emissions	Social Protection
	Pollution	Rights
	Biosphere Integrity	

Considerations
WHO

Underserved Communities | Financial Return

WHERE

Insular	Scalable
Contextualized: Diversified	One-Size-Fits-All: Simplified
Self-Sufficient: Independent	Connected: Collaboration

WHEN

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Immediate Impact	Delayed Impact

Color coding conveys the estimated net impact (green: positive; yellow: neutral; red: negative) for each impact dimension (the WHYs). Impact dimensions derived from Food Systems Countdown Initiative (FSCI) indicator architecture (see further details in Data Empowers Change section).[1] Color coding is similarly used to indicate whether the solution addresses the needs of communities that are underserved and provides financial returns (green: yes; yellow: neutral/unknown; red: no) (the WHOs). For the remaining geographic and temporal scale considerations (the WHERE, the WHEN), sliding scales are provided to convey where on each spectrum the solution falls.

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SAPO *Impact Analysis*

Diets, Nutrition, and Health of local communities are improved, as fish serve as subsistence (food security) and provide a vital source of healthy fats and micronutrients (diet quality). Scaling prediction and early warning systems like SAPO will help maintain regular availability of healthy seafood varieties in the marketplace in the short- and long-term (food environment).

Environment, Natural Resources, and Production will mostly remain unaffected. However, scaling of the solution will have positive environmental impacts relative to the alternative scenario where such prediction and early warning systems do not exist, local fish production becomes instable, and communities must pivot to other food sources. While land use, GHG emissions, water use, and pollution are mostly unaffected by this solution—SAPO may have positive implications for these indicators if local agrifood systems can rely more on sustainable fisheries and less on more resource-intensive agriculture and livestock management. SAPO can also help stakeholders (producers, policymakers) monitor and manage fishery health and adapt to escalating climate change.

Livelihoods, Poverty, and Equity are uplifted and addressed for local, small scale fishers. They may experience increased income and employment, as the SAPO system can help them navigate climate shocks and stresses, and the SAPO 2.0 mobile app version will enable them to better react to the market seafood demands. Similar effects may be felt by seafood processers and distributors (i.e., canning, freezing, transportation), as the supply of seafood and market availability is kept more stable as a result of SAPO.

WHO

The solution directly addresses the needs of low-income, small-scale, and oftentimes marginalized fishers, building their resilience, ensuring their livelihoods, health, and nutrition. However, this solution has not been designed as a for-profit enterprise. While there are positive economic returns for stakeholders (producers, distributors), positive financial returns for investors into such a program would require re-designing the solution into a commercially-viable business model. This could involve a fee-for-service business that generates revenue by having insurance companies cover the cost of such a prediction and early warning system or a paid mobile application that helps producers meet the demands for seafood in the marketplace.

WHERE

Prediction and early warning systems like SAPO can be adapted and scaled to diverse coastal contexts. The system is tailored to the local, Humboldt Current fishing context with relevant indicators, and could be customized to other coastal contexts for fishers around the world. The SAPO 2.0 mobile app helps drive connectivity across the value chain, from producers to marketplace, as well as connectivity to other communities that are involved in trade.

WHEN

SAPO addresses acute crises, producing readouts that inform real-time decision-making for fishers. As a system-changing solution aimed at restructuring how fisheries operate, its impacts are delayed as time has been and continues to be required to develop the technology and integrate lessons learned.

Call to Action for Key Agrifood Systems Stakeholders

In the preceding pages, we explored why a balance of diverse solutions are essential to address our global agrifood systems crisis. We provide a visualization tool for framing the complex trade-offs and considerations for agrifood systems solutions, and compelling case studies that exemplify the central tenets of such a solution set.

These concepts, framework, and data must be translated to action for meaningful change to occur.

The revitalization of our agrifood systems will not be possible without bringing policymakers, private finance, and businesses on board to embrace the necessary solutions. We must aggressively partner, align, and mobilize these key stakeholders within and outside the bounds of traditional agrifood systems in recognition that without change, our shared goals for People, Planet, and Prosperity will remain unmet.

In the pages to follow, we call to action these three key sets of agrifood systems stakeholders with specific, relevant, and timely recommendations in acknowledgement of a diversity of solutions to transform our agrifood systems for People, Planet, and Prosperity.

CALL TO ACTION

Policymakers

WHO

Local, regional, state, and federal governments, including all ministries or departments that interact directly or indirectly with agrifood systems.

This includes: government entities with portfolios invested in agriculture, fisheries, environment, climate change, nutrition, health, economics, commerce, defense, research, labor, transportation, and finance.

WHY SHOULD THEY CARE?

As public servants working for the functioning and betterment of society, policymakers must recognize the tremendous toll global, national, and local agrifood systems have on human and planetary health—a costly burden for federal, state, and local governments alike. The Food and Land Use Coalition (FOLU) estimates that the combined food and land use systems generate "hidden" environmental, health, and poverty costs estimated at almost US$ 12 trillion a year, a number larger than the value of the systems' world output measured at market price.[1] It is policymakers' duty to redesign and create new policies in order to reduce these social, environmental, and economic costs, and transition our agrifood systems to ones that provide equitable returns for all stakeholders.

FINANCING STATUS

Climate financing for agrifood systems is overwhelmingly reliant on public funding, with 85% (US$ 24.2 billion) of total project-level climate finance coming from public sources—58% coming from international and 41% from domestic flows.[2] Development financing institutions (DFIs) combined (national, multilateral, and bilateral) contribute the highest proportion of climate financing, followed by governments—mostly in the form of grants.[2]

PROPOSED APPROACH

National and local government action should prioritize achieving the targets for sustainable development and climate set out in the 2015 Sustainable Development Goals and the Paris Climate Goals by supporting, incentivizing, and promoting sustainable, nutritious, and resilient agrifood systems for all. The key recommendations on the following page provide starting points for policymakers to embrace a diversity of solutions to transform agrifood systems for People, Planet, and Prosperity, with illustrative real-world examples and research that exemplify each recommendation.

RECOMMENDATION	ILLUSTRATIVE EXAMPLE
Position sustainable agrifood systems transformation as a climate agenda and financing priority	Denmark has an ambition goal to achieve a climate-neutral agrifood system by 2050.[3] The country's strategies include improving the feed efficiency of pork and dairy, restoring peatlands, reducing emissions through manure management as well as from nitrogen used in soil and enteric methane, and promoting carbon-friendly foods in its new national dietary guidelines.
Adopt an interdisciplinary, "whole-of-government" approach for sustainable systems change by breaking down siloed efforts and coordinating across agriculture, fisheries, environment, food and nutrition, health, economics, commerce, defense, research, labor, transportation, and finance	The Global Panel on Agriculture and Food Systems for Nutrition's Food Systems Policy Tool supports national and local policymakers in developing "whole-of-government", coordinated approaches to deliver healthier diets and sustainable food systems, with guidance on managing trade-offs between different policy priorities in the delivery of these strategies.[4]
Support, incentivize, and promote the production of a nutritious, nature-positive food supply that promotes the livelihoods and wellbeing of its producers	Scientific modeling analyses suggest that repurposing of up to half of agricultural subsidies to support production of food with beneficial health and environmental characteristics (fruit, vegetables)—and with more equitable distribution of subsidy payments—will improve population health and reduce GHG emissions without reductions in economic welfare[5]
Accelerate innovations and lead by example in ensuring an inclusive, environmentally-friendly, and health-promoting food environment	The New York City Mayor's Office of Food Policy is working to transform the city's food environment for planetary and human health goals. Their comprehensive 10-year food policy plan includes educating students on healthy eating habits and providing greater access to healthy, nutritious, and culturally-appropriate meals in schools; promoting plant-based meals in public hospitals to deliver on nutrition and GHG emission goals; and reducing citywide exposure to unhealthy products such as sugar-sweetened beverages.[6-8]
Partner with the scientific community to drive a translational research agenda that can be leveraged to inform and accelerate evidence-based solutions for People, Planet, and Prosperity	CGIAR is the world's largest public sector research partnership, with direct funding contributions from national governments and regional development banks in Africa, Asia, and Latin America to advance a comprehensive research program and research centers to accelerate global agrifood systems transformation in the context of the current climate crisis.[9]

Private Finance

WHO

Diverse, local, national, and multinational for-profit and philanthropic asset managers and owners, excluding public financing entities.

This includes: venture capital, private equity, pension funds, insurers, family offices, microfinance institutions, corporate capital, and philanthropic funds investing in privately- and publicly-traded enterprises at varying stages of maturity as well as non-profit (501(c)(3)) organizations.

WHY SHOULD THEY CARE?

Beyond the global social imperative for fixing the global agrifood systems, the financial opportunity cannot be overlooked. The financial externalities of dysfunctional agrifood systems, including rising healthcare spending due to diet-related chronic disease healthcare costs, undernutrition, antimicrobial resistance and pollutants; natural capital costs and GHG emissions; reduced rural welfare; and food loss and waste—amount to US$ 12 trillion.[1] The market opportunity combined with these externalities, increasing regulatory and reputational pressures to transition toward Net Zero, and growing consumer demand for sustainable, "better-for-you" foods makes for a strong case for greater private investment in agrifood systems. Further, nature-based systems including agrifood systems are carbon sinks and "greenfields" for carbon sequestration.

FINANCING STATUS

A recent landscape assessment of climate finance for agrifood systems suggested that current climate financing for agrifood systems (US$ 30.8 billion) is well below the estimated annual needs (ranging from US$ 212 billion to US$ 1.3 trillion, depending on source).[2] Private actors channeled US$ 3.29 billion (only 12% of total "project-level" climate finance) plus an additional US$ 2.3 billion in company-level investment into agrifood systems in 2019-20.[2] The vast majority was invested in projects at the intersection of agrifood and energy (US$ 2.81 billion), while financing for production within the agriculture, forestry, and fishery sectors received only US$ 0.35 billion. Commercial financial institutions mirrored this trend, with nearly all of money invested in the agrifood sector going into renewable energy projects. Corporate capital totaled US$ 0.94 billion, almost exclusively in bioenergy.

While these figures illuminate the inadequacy of climate financing for agrifood systems, we know even less about private financing for other impact dimensions (diets, nutrition, and health; poverty, income, and equity) or more granular information about the type of financing, market returns, and impacts secured from these investments.

PROPOSED APPROACH

Private finance operations are diverse in size, stage, scale, scope, and mandate. Consequently, we must embrace that bespoke efforts to integrate climate, health, and social goals into private finance across agrifood systems based on each firms' unique mode of operation, investment thesis, and parameters for assessing risk and return offer the most effective and realistic possibility for increasing private sector capital flows. The recommendations on the following page provide starting points for increasing participation by private finance actors, recognizing the historical risk aversion to investing in agrifood businesses.

RECOMMENDATION	ILLUSTRATIVE EXAMPLE
Mobilize a broader group of private finance players to invest in agrifood businesses, building the proof of concept by showcasing investments with demonstrated impacts and returns	The **Food, Nutrition and Health Investor Coalition (FNHIC)** was established by investors, for investors, to convene a syndicate of diverse asset managers and owners around shared interest in the connection between agrifood systems innovations and human health in the United States. The FHNIC connects agtech, foodtech, healthcare, biotech, pharma, and generalist firms and executives for meaningful exchange and highlights businesses with the potential to deliver measurable impact and commercial financial return, building awareness and creating opportunities for investor members.
Expand thematic scope of investment for a diversity of solutions across the value chain, and build firms' internal technical capacity around health, climate, and livelihoods impacts of agrifood investments	The **Global Agriculture & Food Security Program (GAFSP) Private Sector Window** uses blended finance solutions and concessional funding to support projects designed to improve smallholder farmers' livelihoods living in the world's poorest countries. GAFSP aims to improve food and nutrition security and build the sustainability of agrifood systems, providing financial and technical resources to projects from 'farm to table'.
Identify and implement fit-for-purpose financing instruments such as innovative collaborative funding models, pay for nature incentives, thematic funds, long-term offtake, bundled finance, and technical assistance for supply chain actors to de-risk investment and match the needs of different business models	The Blended Finance Taskforce launched a case study catalogue, "**Better Finance: Better Food**," showcasing 50 new business models across seven financing archetypes that are successfully mobilizing fit-for-purpose capital across public and private entities for sustainable food and land use assets.[12]
Incorporate evidence-based impact measurement and management (IMM) practices that align with the impact architecture proposed by the Food Systems Countdown Initiative (FSCI) across the stages of the investment life cycle (pipeline development, due diligence and underwriting, continuous monitoring, and regular disclosure and reporting)	The **Good Food Institute (GFI) and FAIRR** have developed open-source ESG frameworks for investors and companies to monitor, measure, and report industry-specific risks with respect to the environmental, social, and health impacts of alternative proteins.[13]
Engage with policymakers to drive the necessary incentives, enabling policy environment, and standard-setting governing bodies for greater financial investment and accountability in sustainable agrifood systems	The **International Sustainability Standards Board (ISSB)** builds off market-led reporting initiatives like the Task Force for Climate-related Financial Disclosures (TCFD) and Value Reporting Foundation's industry-based standards (SASB) to provide a high quality, comprehensive global baseline of sustainability disclosures focused on the needs of investors and financial markets. It has support from the G7, G20, International Organization of Securities Commissions, Financial Stability Board, African Finance Ministers, and Finance Ministers and Central Bank Governors from more than 40 jurisdictions.[14]

Business

WHO

All for-profit enterprises operating across agrifood systems value chains.

This includes: large, publicly-traded multinational companies (MNCs) dominating large segments of the market (both by geography and food type), including agricultural input companies, farm, ranch, and fishery businesses, processors, manufacturers, retailers, and food service. It also includes small and medium enterprises (SMEs), as well as early- and late-stage start-ups across agrifood systems value chains.

WHY SHOULD THEY CARE?

Food and agriculture are primarily privately owned and operated, presenting tremendous and diverse business opportunities for budding entrepreneurs and seasoned executives alike. Analyses by McKinsey estimated that food and agribusiness represented a US$ 5 trillion USD industry, 10% of global consumer spending, and 40% of global employment in 2015.[15] Further, estimates suggest that total food demand will increase by 35-56% between 2010 and 2050 as our global population expands to 10 billion people.[16] Transitioning the food and agribusiness sector to one that prioritizes People, Planet, and Prosperity by 2030 is projected to represent US$ 4.5 trillion in incremental business opportunity annually.[1] This includes new markets (e.g., organic food and beverage, fortified foods, agricultural technologies, forest restoration, sustainable aquaculture, plant-based meat), as well as alternative resource allocation and efficiency gains across systems (e.g., product reformulation, reducing food waste across the value chain).

FINANCING STATUS

According to the World Benchmarking Alliance, 350 companies account for greater than half of revenue (US$ 8.7 trillion in 2020) in food and agriculture globally and employ 23 million people.[17] Only 26 of these companies have set GHG emission reduction targets aligned with the Paris Agreement (and 188 have no targets at all). Further, only 5% (out of 233 assessed) have set targets to increase the proportion of healthier options, only 20% (out of 233 assessed) are addressing the affordability and accessibility of nutritious foods, and less than 15% of companies are taking sufficient action to prohibit child and forced labor.[17] Given MNCs' significant geographic and demographic reach, environmental footprint, and employment coverage of the agrifood industry, they have great potential (and thereby accountability) to drive agrifood systems transformation across the supply chain for People, Planet, and Prosperity.

At the same time, SMEs are critical to food supply chains globally, and must also be recognized for their impact on equitable planetary and human health returns. Of the 570 million farms worldwide, 84% are smallholder or micro-farms (land size less than 2 hectares).[18] Small and medium farms (<50 ha) produce more than half of all calories (and more than 75% of food commodities in sub-Saharan Africa, South and South East Asia).[19] In Africa, over half of production of fruits, vegetables, animal-source foods, cereal, and legumes comes from SMEs, and 70-100% of foods at the retail stage are sold via SME outlets.[20]

PROPOSED APPROACH

While there is significant heterogeneity in the size, scope, value-chain focus, customer base, geographic reach, and goals of food sector enterprises, all businesses can incorporate measurable changes into their commercial activities, operations, and commitments for agrifood systems transformation. Filling corporate social responsibility/philanthropic quotas will be insufficient for ensuring true accountability and impact. The recommendations below provide starting points for businesses to embrace a diversity of solutions to transform agrifood systems for People, Planet and Prosperity, with illustrative, real-world examples of businesses exemplifying each recommendation.

RECOMMENDATION	ILLUSTRATIVE EXAMPLE
Incorporate regular data collection and monitoring around impact metrics aligned with the latest, accredited impact measurement frameworks (e.g., Food Systems Countdown Initiative [FSCI], International Sustainability Standards Board [ISSB], etc.) for human health, climate, and equitable livelihoods goals	HowGood is the largest food sustainability database and independent research company, supporting businesses in their efforts to measure, improve, and communicate their sustainability impact in a responsible and transparent way. HowGood provides ingredient-level environmental and social impact data on products, empowering companies to make strategic decisions in sourcing, manufacturing, merchandising, and marketing of products.[21]
Collaborate with supply chain partners and suppliers to ensure efficient data collection and knowledge sharing to achieve shared agrifood systems goals for People, Planet and Prosperity	Tyson Foods, the world's second largest processor and marketer of chicken, beef and pork, is collaborating with value chain partners and leveraging the power of big data to bring lower-emissions beef to market in order to meet its Net Zero emissions goals across its global operations and supply chain by 2050. Their bespoke model aims to estimate GHG emissions for each head of cattle from feed cultivation through to slaughter and packaging. This requires highly collaborative relationships with supply chain partners and frequent communication to ensure accurate data is collected to calculate the decarbonizing impact of Tyson Food's operations.[22]

Continued on next page...

RECOMMENDATION	ILLUSTRATIVE EXAMPLE
Ensure access to affordable, nutritious diets whether operating at the production level (diversifying crops; improving soil health; and if necessary biofortifying) or consumption level (increasing healthy product portfolio/menu options, as defined by a validated nutrient profiling system; increasing availability, affordability, and cultural relevance of healthy foods; and supporting awareness campaigns and education about dietary shifts aligned with positive human and planetary health outcomes)	FrieslandCampina, a multinational food manufacturer operating in 30 counties, has a Broadening Access to Nutrition program focused on increasing access to affordable, nutritious products for lower income groups and individuals with reduced access to essential nutrients. The program aims to increase the share of affordable nutrition products in lower income markets (Sub-Saharan Africa, Indonesia, Malaysia, Pakistan, Philippines, Thailand, Vietnam) to at least 15% of sale volume in 2025, and to increase the share that complies with the criteria for Affordable Nutrition of the FrieslandCampina Global Nutritional Standards to at least 50% by 2025.[23]
Adopt climate friendly, regenerative agrifood production practices aligned with the latest scientific evidence to cut GHG emissions, enhance biodiversity, improve soil health, and reduce food loss and waste	One Planet Business for Biodiversity (OP2B) is an international, cross-sectorial, action-oriented business coalition housed by the World Business Council for Sustainable Development to drive systemic change to protect biodiversity across the agrifood system value chain. For each of OP2B's pillars—scaling up regenerative agriculture; enhancing cultivated biodiversity; and protecting high-value ecosystems—the coalition helps generate awareness, prioritize actions, and develop reporting and tracking methodologies.[24]
Support the resilience of producers and workforce within supply chains through the provision of structural and capacity building interventions (knowledge, technology, resources), while also addressing the opportunity for stable access to a living income and affordable, healthy diets	Working with the Fair Wage Network, Unilever, a multinational, consumer-packaged good (CPG) company with 400 brands in over 100 countries, has set a target to ensure that employees of companies that they interact with in the value chain earn at least a living wage or income by 2030. It already provides a living wage to all its employees.[25] Bayer, one of the world's leading crop science companies, aims to support 100 million smallholder farmers in low and middle income countries by 2030 through digital farming and market access tools, modified product portfolios, biotech solutions, and partnership formation along the value chain. Bayer's efforts to help smallholder farmers gain access to the value chain and reduce business risks align with impact goals of increasing producers' productivity, income, and long-term food security and resilience.[26]
Partner with research institutions and non-profit organizations to build the scientific evidence relevant to driving human health, planetary health, and equity goals	In April 2022, iFoodDS and Cornell University partnered on a no-cost COVID modeling tool to helps prevent the spread of COVID-19 infection within agrifood industry workforce and improve resilience of agrifood supply chains. The first release focused on farmers and then further expanded to processing facilities.[27]

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