THE ROLE OF INNOVATION IN TRANSFORMING THE GLOBAL FOOD SYSTEM





EXECUTIVE SUMMARY

OVER THE LAST 50 YEARS the global food system has managed to increase production faster than the growth in global population, leading to significant reductions in hunger as a percent of population. However, this growth has not come without costs to land, water, and air. Despite the advances in the fight against hunger, hundreds of millions of people remain food-insecure. Furthermore, cheap, plentiful calories, combined with changes in our food environment, have resulted in huge increases in obesity. This report examines some of the efforts aimed at addressing these problems, identifies some limitations of these efforts, and highlights the need to emphasize *the role of innovation* in order to deliver a food system that benefits people and the planet.

• **Transforming the food system** to be more sustainable and resilient provides one of the best opportunities to create change for the better. An improved food system will not only promote rich biodiversity and ecosystems, but people who are resilient and empowered.¹

• Many organizations are waking to these challenges and calling for changes to how food is **produced**, **processed**, **and consumed**, from the United Nations to the World Economic Forum. By considering the food system as a whole, we are, in theory, better positioned to understand problems and to address them in a more connected and integrated way.

• Some of these organizations have positioned modern farming methods and, at times, farmers themselves as the problem to be solved.

Decisions about how and what to grow inevitably result in trade-offs. Over the last fifty years, advances in farming practices and technologies, such as the Green Revolution, **dramatically reduced global hunger as well as deforestation**, but they also had negative consequences, including **loss of soil fertility, soil erosion and toxicity, diminishing water resources, and pollution** of underground water. The alternative, of course, was massive starvation and increasing hunger that would have also had their own negative impacts on the environment.

• By framing the current food system as the problem and, by contrast, low-input food systems, such as regenerative and organic farms, as the primary solution to the ills caused by food production, new initiatives may limit the range of policies and technologies available to

address the problems. Positioning the current food system as broken may also **undermine confidence in the food we eat and limit future innovations** that advocate intensification along with regeneration.

• To address the very real challenges faced by people and the planet we will need to use *all* tools at our disposal. This includes advances in food production that regenerate soil and sequester carbon, but also innovations that allow **more food to be produced on the same land using fewer inputs.**

• Initiatives aimed at transforming the food system cannot succeed in delivering the benefits desired without acknowledging **the role innovation played in the past** and ensuring that it plays an equally robust role in the future.

¹ Food Systems Summit, United Nations, https://www.un.org/sustainabledevelopment/food-systems-summit-2021/

THE NEED For Change

THE GLOBAL food system encompasses all the people on the planet and the entire range of organizations involved in feeding the world population. This includes all the interconnected activities involved with growing, harvesting, packing, processing, distributing, selling, storing, marketing, consuming, and disposing of food.

Despite producing more food than ever, there are still nearly 700 million people undernourished and over 2 billion people facing moderate to severe food insecurity. The situation has grown more severe as COVID-19 has led to increased unemployment, which disproportionately impacts lower-income communities. Meanwhile, about 2 billion people are overweight or obese, contributing to a growing incidence of food-related diseases.² At the same time, an estimated one third of all food produced globally is lost or goes to waste.

Climate change is creating more challenges to food production due extreme weather conditions, such as droughts, floods, and fires around the world. However, our global food system is also a part of the problem. According to the United Nations:



UN State of Food Security and Nutrition in the World: http://www.fao.org/3/ca9692en/online/ca9692en.html Food Systems Summit, United Nations, https://www.un.org/sustainabledevelopment/food-systems-summit-2021/

CALL TO ACTION



IN ADDITION to the public health and environmental challenges outlined above, the COVID-19 pandemic has brought into sharp relief further limitations of the current food system related to long supply chains, consolidation of food processing centers and rigid distribution channels. For the first time in a long time, the public is paying attention. There is a growing awareness of the contributions of food and agriculture to health and environment challenges.

Many organizations are calling for changes to how food is produced, processed and consumed, from the EAT Lancet Commission's report, which recommends changes to what we eat, to the European Commission's Farm to Fork Strategy, which rethinks how we produce food. There are also a number of private sector food system initiatives, including activities by the World Economic Forum, WBCSD, and the Sustainable Food Policy Alliance.

Many governments, companies, foundations and other institutions support, by words or action, the UN's Sustainable Development Goals, which include a number of goals for food related to health and the environment. The UN Secretary General is calling for collective action and global commitments to radically change the way food is produced, processed, and consumed, to achieve a sustainable, equitable, and secure food future. To this end, the United Nations will convene a Food Systems Summit in 2021 to raise awareness about the need to "resolve not only hunger, but to reduce diet-related disease and heal the planet."⁴ The UN Food System Summit is the leading initiative to develop specific recommendations for governments. The UN is engaging with Member States and other stakeholders to establish consultations, including regional and national consultations.

The preparatory process for the Summit will engage civil society, farmers, indigenous peoples, governments, the private sector, research institutions, think tanks, and implementing agencies. The Summit will look to individuals and communities who have the most to gain or lose from the way our food system functions for input and direction.

⁴ Food Systems Summit, United Nations, https://www.un.org/sustainabledevelopment/food-systems-summit-2021/

LIMITATIONS OF THE CURRENT APPROACH

The **EAT Lancet Commission** report puts it this way:

"Nothing else we do has come close to how food, agriculture, and land use are causing global environmental harm. Without major changes, our food system will continue to push Earth well beyond its planetary boundaries.

Beyond these environmental concerns, the world's current food system also contributes to significant human failures. On the one hand, a sizable fraction of the world still faces crippling food insecurity and under-nutrition, while on the other hand, hundreds of millions of people face serious health challenges including obesity, diabetes, and heart disease—linked to unhealthy diets."⁶

The United Nations Environment Program's report, The New Deal, is even more blunt

BY CONSIDERING the entire food system, we are, in theory, better positioned to understand problems and to address them in a more connected and integrated way. How a problem is framed often determines the range of policies and the suite of technologies available to address the problem. The impact of framing can be seen in conversations about how to improve the food system. Unfortunately, many international organizations, including conservation organizations, describe modern farming methods—sometimes referred to as 'industrial agriculture,'⁵—using a negative frame, which positions agriculture and farmers as the problem to be solved.

Each initiative or report frames the challenge in a slightly different way, but the thrust of most reports is clear—the global food system is failing people and the planet.

in its assessment of the deficiencies of the current food system with particular emphasis on industrialized farming, but a general disdain or antipathy for modern agricultural methods can be discerned in other initiatives and reports as well. According to **the UNEP**,

"The way we produce and consume food is causing major environmental and human health problems such as polluted water, depleted soils, the wholesale loss of forests and the species that call them home, release of enormous quantities of greenhouse gases, and wasted food clogging landfills. A toxic cocktail of unsustainable agricultural expansion, fueled by pesticide and fertilizer use is fragmenting and shrinking natural space. At the same time, the world's food needs are not being met while around a third of the food produced is wasted. World leaders need to commit to a new set of measures that will put agriculture on a clean and sustainable track."⁷⁷

The Union of Concerned Scientists has a similar take:

"Industrial agriculture is currently the dominant food production system in the United States. It's characterized by large-scale monoculture, heavy use of chemical fertilizers and pesticides, and meat production in CAFOs (confined animal feeding operations). The industrial approach to farming is also defined by its heavy emphasis on a few crops that overwhelmingly end up as animal feed, biofuels, and processed junk food ingredients."⁸

⁵ In the US, the term "industrial agriculture" describes the input-heavy agriculture system of the 70's and 80's, whereas current agriculture practices are much more information-intensive. Yield and quality improvements on farms result from more precise application of limited inputs, not more inputs. Public perception of 'modern agriculture' as synonymous with 'industrial agriculture' does not reflect the reality of the modern farm.

⁶ Diets for a Better Future, EAT Lancet Commission, https://eatforum.org/knowledge/diets-for-a-better-future/

⁷ The New Deal, UNEP, https://wedocs.unep.org/bitstream/handle/20.500.11822/28333/NewDeal.pdf

⁸ "The Hidden Costs of Industrial Agriculture," https://www.ucsusa.org/resources/hidden-costs-industrial-agriculture



The Food and Agriculture Organization (FAO), the leading UN food development agency, works to improve the lives of farmers by supporting "local solutions and linkages with the local economy and local markets." The emphasis on local solutions often leads to recommendations consistent with agroecological methods, rather than modern farming practices. As a result, there is little emphasis on technology and innovation.⁹ FAO is often viewed by the private sector and some governments as downplaying or discouraging technological approaches, such as genetic engineering and gene editing, for smallholder farmers.¹⁰

If modern agricultural methods are destroying the planet, what then can be done to save it?

According to the Food and Land Use Coalition Global Consultation report,

"alongside improvements in mainstream high-input agriculture, a **regenerative farming** movement is emerging. There are a number of definitions of regenerative agriculture. For the purposes of this report, a broad definition is used that includes a set of practices that regenerate soil, that reduce but do not necessarily eliminate synthetic fertilisers and pesticides, and that go beyond the reduction of negative impacts to ensure that agriculture has a positive environmental effect. It seeks to maintain high levels of productivity while reducing inputs, to restore soil health, to increase agrobiodiversity and to reduce negative effects on freshwater and the ocean. It is supported by related techniques such as sustainable land management and integrated water resource management."¹¹

Consumer packaged goods (CPG) companies like Nestle and Unilever are often the lead private sector stakeholders involved in these initiatives. They are closer to consumers than farmers and agribusinesses in the value chain, and may be more sensitive to consumer demands around practices like regenerative agriculture. For example, General Mills has committed to advancing regenerative agriculture practices on 1 million acres by 2030, which represents about 20% of the company's agricultural farmland footprint in North America.¹²

⁹ http://www.fao.org/agroecology/overview/en/

¹⁰ FAO Statement on Biotechnology has not been updated since March 2000, http://www.fao.org/biotech/fao-statement-on-biotechnology/en/

¹¹ The Global Consultation Report (2019), Food and Land Use Coalition, https://www.foodandlandusecoalition.org/global-report/

¹² General Mills Commitment to Regenerative Agriculture, https://www.generalmills.com/Responsibility/Sustainability/Regenerative-agriculture

WHAT'S MISSING?

If intensive agriculture is the problem, what would the state of global forests be like without it?



DESPITE THE language used in the Food and Land Use Coalition report and others, there is no inherent conflict between regenerative agricultural practices and modern farming methods. The conflict arises from the way the problem is framed, with regenerative agriculture viewed as *good* and modern agricultural practices viewed as *bad*. This dichotomy is also simplistic given that innovations in agriculture go well beyond breeding and agronomy and include input management, financial services, risk management, market infrastructure and access, etc. Furthermore, farmers in the developing world are often more focused on feeding their families than achieving sustainability metrics.

With the exception of reports from the World Resources Institute, each of the other reports and initiatives fails take into consideration the historic contributions of agriculture to reducing global hunger and reducing pressure on global forests. These benefits have occurred because agriculture has changed over time. Because the reports gloss over the past benefits of agriculture to human health and the environment, there is no discussion of **the role innovation has played**, and continues to play, in improving agriculture to the benefit of the food system. The fact is, agriculture today in most places around the world, including in the United States, Europe, China, India and Brazil, bears little resemblance to the practices of 1950, 1980, or even 2010.

The World Wildlife Fund Living Planet Report illustrates the importance of having a baseline to compare wildlife populations today to populations in the past. By comparing populations in 1970 and today, we see clearly the remarkable decline that has occurred. Much of the loss in animals has resulted from habitat loss and much of that habitat has succumbed to expanding agriculture, particularly intensive, modern forms of agriculture.

If intensive agriculture is the problem, what would the state of global forests be like without it?

Without the huge increases in productivity that have resulted from the intensification of agriculture over the last fifty years, farmers would have needed 1 billion hectares *of additional farmland* to produce the same amount of food. This would entail the conversion (*i.e.* deforestation) of 20 percent of the remaining forests to farmland.



The intensification of agriculture through the adoption of new innovations and agricultural practices saved that 1 billion hectares of forest just as it drove down the rate of hunger from 36 percent of people on the planet 50 years ago to less than 10 percent today. The next section will explore how current efforts to transform the global food system have failed to take into account the historic role of innovation in delivering public health and environmental benefits.

These disagreements about baselines and framing can be reduced through greater interaction

between the different actors working for sustainable food systems. Each of the initiatives discussed presents an opportunity for food and agriculture companies and industry associations to contribute to these dialogues and highlight the critical work they do to sustainably and nutritiously feed the world as well as the work they are doing to improve the system moving forward.

It is in the interest of all of the initiatives as well as the authors of the reports to reconsider how they are framing these discussions. After all, how challenges are framed will influence the types of organizations that are willing to participate in addressing the problem, which will have a big impact on whether or not problems are solved. The EAT Lancet Commission has experienced firsthand the pushback that can occur when parts of the food system feel under attack by proposals. The EAT Lancet report is viewed by many in the livestock and farm community as disparaging livestock production. As a result, it becomes difficult to engage with critical stakeholders in the livestock sector to achieve the objectives of the initiative.

THE INNOVATION GAP

"Innovations in technology—as well as policy, financing, and business models are essential to nourish the world in a safe, responsible, and sustainable way. To improve global food security and nutrition, different players and stakeholders must come together to acknowledge gaps and share approaches for addressing them. We have an incredible opportunity to work together to use technology and innovation to create more inclusive and sustainable food systems."

> David W. MacLennan Chairman and Chief Executive Officer, Cargill

THE WORLD Economic Forum report Innovation with a Purpose lays out an innovation agenda, identifying emerging technology innovations that have the potential to drive rapid progress in the sustainability, inclusivity, efficiency, and health impacts of food systems to achieve the Sustainable Development Goals. Unlike many other reports, innovation is framed as a positive force for addressing real challenges. The WEF Innovation report focuses on 12 key technology applications. The report estimates the concrete benefits which could be delivered in terms of reduced water usage, greenhouse gas emissions, and food waste; increased productivity and farmer income; and reduced obesity and undernourishment of consumers. It also highlights the significant economic, environmental and health benefits that could be realized through the broad adoption of certain technologies and enabling

actions that can support and scale them.

Despite the strong recognition of the contributions of innovation in the past, the report raises hypothetical risks for some technologies while ignoring similar risks for other innovations described in the report. For example, after highlighting the many ways gene editing could contribute to sustainable and nutritious food systems, the section closes by noting,

"gene editing has its attendant risks. First, given the transaction costs of serving small-scale farms, seed innovation is likely to be geared first towards developed countries and small farms run the risk of being left out. Second, the concentration of intellectual property in relatively few hands could create economic oligopolies or monopolies that would limit the technology's use to only a few types of seeds. This could result in less biodiversity. Third, if used irresponsibly, gene editing could present risks to human health and environmental biodiversity. Greater research and public dialogue is crucial for managing all of these risks and ensuring fair distribution and accessibility for smallholders to such innovations."¹³

The same argument could have been made for cell phone technology, which was originally marketed to consumers in developed countries with no consideration of smallholder farmers. Intellectual property resides in the hands of a few companies and irresponsible use could undermine civil society. Market forces, rather than public dialogue, delivered phone to farmers in Africa who use the technology to get prices for their crops.

¹³ Innovation with a Purpose, World Economic Forum, https://www.weforum.org/reports/ innovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation



Net Agricultural Land Expansion (2010-50)





Furthermore, while innovation is positively framed in the WEF report, agriculture itself is once again framed as a problem to be solved. Such framing makes it more difficult to engage the broad range of food and agriculture stakeholders necessary to bring a vision to life.

Without a positive frame of reference for innovation, companies developing innovative new products such as gene editing or microbial soil amendments, but also including alternative proteins like cell-based meat and fermented

dairy proteins, are all at risk of being sidelined in these discussions.

The one report where innovation and especially productivity is highlighted as critical for achieving sustainability and climate goals is the World Resources Institute report Creating a Sustainable Food Future. In fact, the majority of improvements needed to avoid expansion of agricultural land and reduce GHG emissions is assumed under their model based on historic trends.14

It is particularly striking to note how extensively the WRI report relies on historic productivity trends continuing to achieve their goals. In terms of land expansion, agriculture would have to expand its footprint by 3,250 million hectares without productivity gains. However, the continuation of historic gains will get us 85 percent of the way to their 2050 target. In terms of GHG emissions, historic gains will close more than 60 percent of the gap to the target.

¹⁴ Creating a Sustainable Food Future, World Resources Institute, https://research.wri.org/ wrr-foodinnovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation

WHAT IS AT STAKE?

"science tells us what we CAN DO, while the public or the consumer tells us what we SHOULD DO."

ACCORDING TO the World Resources Institute report Creating a Sustainable Food Future,

"The single most important need for a sustainable food future is boosting the natural resource efficiency of agriculture, that is, producing more food per hectare, per animal, per kilogram of fertilizer, and per liter of water. Such productivity gains reduce both the need for additional land and the emissions from production processes. Without the large crop and livestock productivity gains built into our baseline (based roughly on trends since 1961), land conversion would be five times greater by 2050 and GHG emissions would be more than double the level projected in our baseline.

"In some mitigation analyses, including reports by the Intergovernmental Panel on Climate Change (IPCC), agricultural productivity gains are barely mentioned, for reasons that are unclear. Even under our baseline projection, with its large increases in crop and livestock yields, we project that agricultural land will expand by 593 M ha to meet expected food demand. Unless projected growth in demand for food can be moderated, to avoid land expansion both crop yields and pasture-raised livestock yields will have to grow even faster between 2010 and 2050 than they grew in previous decades."¹⁵

New technologies have tremendous potential to benefit society and food production as part of a more sustainable and nutritious food system. Companies like Corteva have developed sustainability goals and metrics to assess their progress. However, science tells us what we can do, while the public or the consumer tells us what we should do.

The social license to develop a technology to its full potential is dependent on public support and market acceptance. Traditionally it has been assumed that sound science and appropriate government oversight will result in social acceptance of innovation.¹⁶ However, the history of agricultural biotechnology, or GMOs, has taught us that *information alone cannot address public concerns*.

According to research from The Center for Food Integrity (CFI), what consumers want first and foremost is to know that food producers *share their values*, like producing safe, affordable, nutritious food in a manner that protects the environment.

International initiatives that lay the framework for an equitable food system that protects people and the planet could provide the social license needed to ensure that new innovations make their way to market and that international markets are open as well. Unfortunately, by framing the current food system as the problem and low-input food systems as the solution, **these initiatives risk further undermining consumer confidence in new technology, which puts at risk the potential of technology to make the food system better for people and the planet.**

¹⁵ Creating a Sustainable Food Future, World Resources Institute, https://research.wri.org/wrr-food

¹⁶ https://www.corteva.us/who-we-are/sustainability.html

TRADE-OFFS



THERE ARE inevitable trade-offs between the various initiatives' goals of reducing the impact of agriculture on the environment, preserving affordability of food, increasing access to nutritious food, and enhancing economic returns. Unfortunately, there is little discussion in the various reports and initiatives about how to navigate these tradeoffs, with the exception of the **Farm to Fork Strategy** and the work of the World Resources Institute.

The FtF Strategy recognizes that trade-offs may occur in terms of lower production and higher costs. However, rather than accept that tradeoffs are inevitable and discuss the impacts of policy decisions, the FtF Strategy suggests that it is possible to eliminate the trade-offs by taking steps to raise sustainability standards globally.

The FtF Strategy states, "There is an urgent need

to reduce dependency on pesticides and antimicrobials, **reduce excess fertilization**, **increase organic farming**, **improve animal welfare**, **and reverse biodiversity loss**." (emphasis in the original) The FtF Strategy prioritizes local impacts over global impacts, which is to say local sustainability over global. For example, the FtF Strategy highlights the need to reduce use of pesticides and fertilizer and to bring 25% of the agricultural land of Europe under organic production by 2030, despite the fact that the Commission issued a report in 2019 indicating the organic production was 36% less productive under real-world conditions.¹⁷

Organic systems tend to be more expensive to maintain and *less productive*. As a result, the FtF Strategy is likely to make food more expensive in Europe, which would normally lead to more imports. However, the FtF Strategy notes "The EU is the biggest importer and exporter of agri-food products and the largest seafood market in the world. The production of commodities can have negative environmental and social impacts in the countries where they are produced. Therefore, efforts to tighten sustainability requirements in the EU food system should be accompanied by policies that help raise standards globally, in order to avoid the externalization and export of unsustainable practices." Raising standards globally would also mean increasing food costs globally, which would negatively impact hunger.

Recommendations for transforming the food system that fail to take into account the trade-offs that will inevitably occur will make it more difficult, not less, to reduce the impact of agriculture on the planet.

A COMMON VISION

Promoting a positive vision for the future of the food system is critical.



THE DEBATE over how to address global food challenges has become deeply polarized, sometimes pitting modern agriculture and global commerce against local food systems and regenerative farms. The arguments can be fierce and the stakeholders seem to be getting ever more divided.

Those who favor modern agriculture focus on advances in mechanization, irrigation, fertilizers, data and improved genetics to increase yields to help meet demand.

Meanwhile, proponents of local and regenerative farms point to the benefits of more holistic approaches that improve fertility without synthetic fertilizers and pesticides.

Both approaches offer badly needed solutions and neither can get us where we need to be alone. We need a food system that *welcomes* all good ideas, whether from regenerative farms or high-tech farms, and blends them together to make a whole that is greater than the sum of its parts.

Effective joint action usually involves a common vision about what is a working food system, an understanding of where positions on the vision diverge, and increasing degrees of agreement on how to realize the vision.

Achieving a common vision is easier if different actors use similar scientific analyses of what people need to be well nourished, and of the boundaries to the safe use of planetary resources. They will also want to take account of power relations, to understand how markets work and to appreciate the range in capabilities for producing, processing and purchasing food.

Promoting a positive vision for the future of

the food system is critical. Humanity has more knowledge, technology, social intelligence, and human capacity than ever before, all of which can be harnessed to create a food system that nourishes all people, grows the global economy, and protects a thriving environment. Despite this great potential, we have yet to see a credible and inspiring vision for our future global food system that can unite all stakeholders and ignite a movement toward positive change.

Current initiatives aimed at transforming the food system cannot succeed in delivering the benefits desired without acknowledging that past innovation has lifted billions out of hunger and poverty while avoiding the need to cut down one billion hectares of forest. This leads to a recognition that innovation will be just as critical to the success of the food system we seek to implement.



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