

WHITE PAPER

Improving Our Global Food System

The Key to Human, Animal, and Environmental Progress

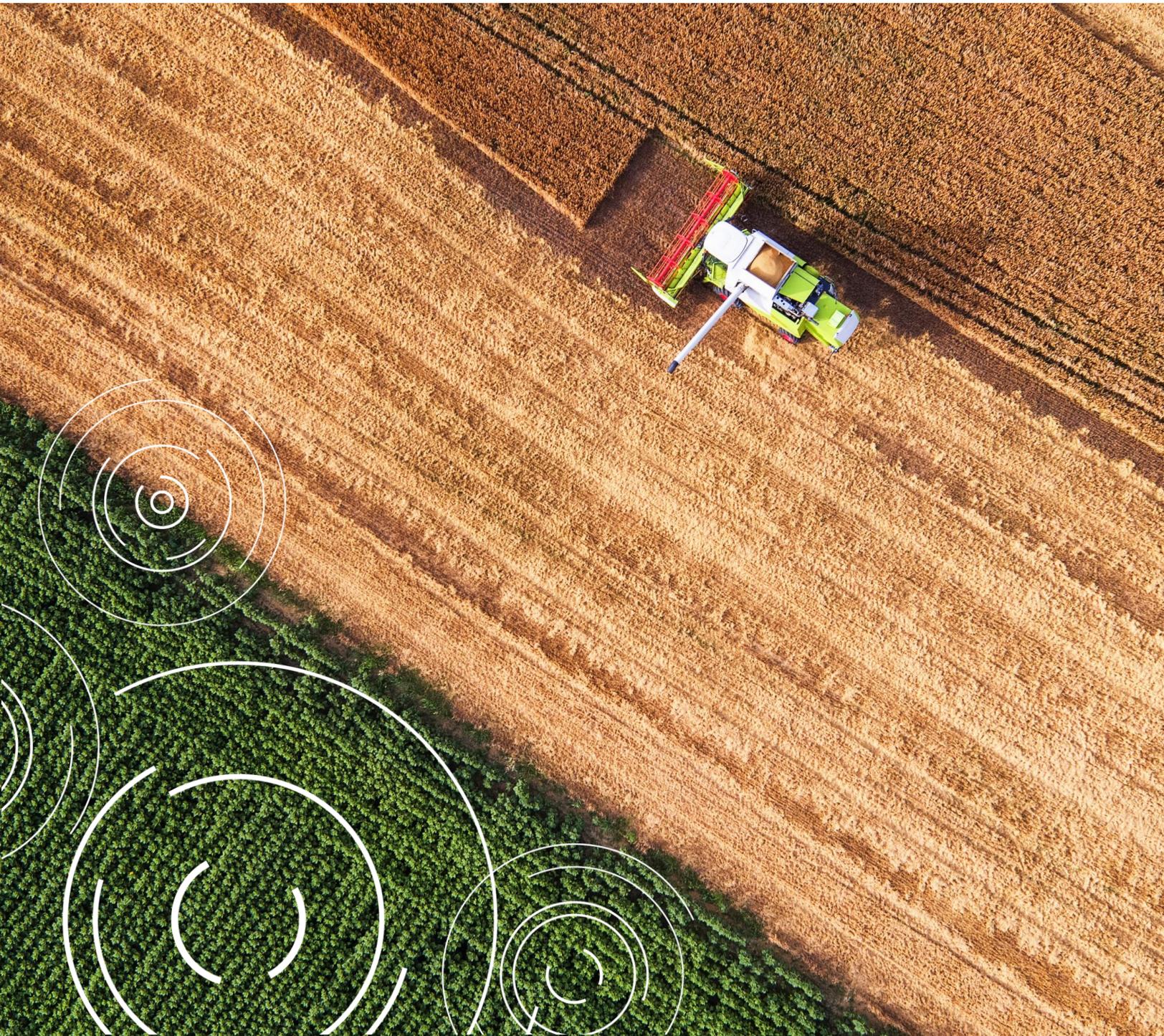


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Synopsis

How the world's food is produced, consumed, and discarded has immense impacts on human and environmental wellbeing. Our food system provides a barometer for the success of our economies and the depth of our dedication to equitable sustainable development. Food production currently occupies or impacts nearly half of Earth's habitable land,¹ while agriculture sustains each of us with daily energy and provides employment for one-third of humanity.² Today's farming methods produce staggering yields, incredible choice, and global supply chains that serve an interconnected world.

However, serious weaknesses in the current food system are evident. From an environmental perspective, industrial farming methods pollute land, water, and air, destroy biodiversity, and contribute significantly to the greenhouse gas (GHG) emissions that drive global climate change. From a human perspective, inequality and imbalance within the industrial food system are persistent and deepening. The system fails to provide sufficient access to nutritionally adequate food for much of humanity, creating overlapping problems of hunger, malnutrition, stunting, overweight, and diet-related health problems. From an economic perspective, our industrial food system is focusing on short-term profits at the expense of long-term performance. By prioritizing private profit over public wellbeing, the food industry is failing to invest in long-term equity and sustainability.

A healthy food system is the backbone for achieving the United Nations' (UN's) seventeen Sustainable Development Goals (SDGs), an agenda for human progress through 2030 (see Box 1). In 2021, recognizing the foundational role of the food system in enabling human progress, the United Nations intends to hold a Food Systems Summit with the stated purpose of transforming food production and consumption to deliver progress on the SDGs. However, the event planning process has so far revealed deep support for multinational corporate interests, calling into question its ability to generate inclusive solutions that ensure the public good.

Box 1: The UN Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are seventeen goals for global societal advancement that were developed at the 2012 United Nations Conference on Sustainable Development held in Rio de Janeiro in 2012, and later adopted by all UN member states in 2015. The UN Development Program (UNDP) recognizes that the SDGs are connected and interdependent, and progress will require coordinated international efforts.

Improvements in the global food system are urgently needed to achieve at least thirteen of the seventeen goals, highlighted below. If organized and run according to the interests and of people, animals, and environments worldwide, the 2021 UN Food Systems Summit could be an important catalyst for transformative action to deliver a food system that is dignified, just, and sustainable.

UN SDGs (‡ denotes those dependent upon an improved food system)

- ‡ SDG 1: End poverty in all its forms everywhere.
- ‡ SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
- ‡ SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.
- ‡ SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- ‡ SDG 5: Achieve gender equality and empower all women and girls.
- ‡ SDG 6: Ensure availability and sustainable management of water and sanitation for all.
- ‡ SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.
- ‡ SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
- ‡ SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
- ‡ SDG 10: Reduce inequality within and among countries.
- ‡ SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
- ‡ SDG 12: Ensure sustainable consumption and production patterns.
- ‡ SDG 13: Take urgent action to combat climate change and its impacts.
- ‡ SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- ‡ SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably. manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss.
- SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels.
- SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Solving the problems of the modern industrial food web will require revolutionizing the way we farm, the way we do business, and the way we eat. We must replace the weaknesses and abuses of industrial agriculture with more sustainable methods that better meet the needs of people and animals worldwide, while safeguarding and regenerating natural environments.

As part of this revolution, we must recognize that many of the worst challenges of today's food system come from the intensive production of industrial livestock to meet growing demand for meat and animal products by the world's wealthier consumers. Creating a food system that can support the SDGs will require shifting away from industrial livestock—prioritizing instead diverse, ecological, plant-forward food production and intelligent protein investments.

I. The Costs of Today's Industrial Food System

Agriculture is currently humanity's single most wide-ranging impact on land, occupying forty percent of Earth's ice-free surface.^{3,4} Primary agricultural production also employs one in three workers worldwide.⁵ The Food and Agriculture Organization (FAO) of the UN estimates the annual economic value of global agricultural production at \$6.2 trillion.⁶ The World Bank estimates that value-added agriculture contributes a further \$3.5 trillion,⁷ and that food service and food retail likely generate two to five times the value of farm production.⁸

75–80% of the world's agricultural land is used to produce livestock and their feed crops.

Our food system has also undergone deep and lasting changes since the beginning of the twentieth century. Between 1900 and 2019, world population grew from 1.6 billion to 7.7 billion people,⁹ adding the last 1.5 billion people in just 15 years. To support this growing population, the scale, methods, and technologies of food production changed just as dramatically: The twentieth century saw the development of powerful new synthetic fertilizers and agrichemicals, supported by the chemical and manufacturing industries that had powered World War I and World War II. Modern patterns of industrial agriculture expanded throughout the high-income nations by midcentury, supported by important developments in food packaging, processing, and refrigeration.

During the Green Revolution of the 1950s and 1970s, industrial chemicals and new, high-yielding versions of staple crops were introduced by scientists in the United States to low-income and middle-income nations around the world as a solution to hunger (and a bulwark against Communism), restructuring rural economies across much of the world in ways that continue to be felt today.¹⁰⁻¹¹ This turn toward globalized, chemical-intensive agriculture established industrial food production, giving rise to today's global food system. Now, decades

later, it has become clear that industrial food has delivered unevenly on its promises to address hunger, while leaving in its wake very high social and environmental costs.¹²

Social Costs of Industrial Agriculture

Industrial agriculture and the Green Revolution sought to feed growing global populations by helping farmers fight the pests and diseases that reduced yields of staple crops. While this approach did raise grain productivity and contribute to preventing famine in some areas of the Global South, it also revealed the political and technological biases of the early twentieth-century Global North. Its ongoing impacts on rural economies in the lower-income nations have been profoundly mixed. Many farmers who adopted patented new seeds and agrichemicals on the promise of higher yields and prosperity found that the productivity gains were temporary, while the ongoing costs of these inputs trapped them in a downward economic spiral.¹³ In high-income nations, the reorganization of agriculture to most efficiently produce industrial input crops like wheat, corn, soybeans, oilseeds, and sugar-beets has led to a food system dominated by meat, processed foods, and corporate monopolies.¹⁴

Industrial food production grows corporate wealth—not human or environmental wellbeing as articulated in the UN SDGs.

Despite the midcentury production gains, today's industrial food system still falls far short of providing all people with reliable and equitable access to adequate healthy food. FAO estimates that 820 million people worldwide still go chronically hungry,¹⁵ a number that has increased in the last several years rather than falling. As of 2018, global analysis supported by the World Health Organization (WHO) finds that 22.2 percent of children under five years old are stunted due to poor nutrition, and 7.5 percent suffer from wasting. Meanwhile, unbalanced food access

causes overnutrition and overweight for 38.9 percent of adults and 5.6 percent of children under five.¹⁶ Many more people worldwide face nutritional deficiencies and rising rates of diet-related non-communicable diseases (such as diabetes and heart disease), linked in part to the oversupply of cheap calories from processed foods produced by industrial agriculture. Additionally, FAO estimates that one-third of all food produced globally is never consumed, instead going to waste at harvest, in the supply chain, on retail shelves or on our plates.¹⁷

Which crops are prioritized, and how food is distributed, create the twin problems of hunger among the poor and overabundance among the wealthy. The food system currently produces more than enough total calories to nourish the 7.7 billion people alive today, but not all of that food is in a form that can be used to fight global hunger (for example, the inedible crops produced for biofuels and livestock feed).¹⁸ Demand for meat and dairy foods by wealthier consumers worldwide drives the use of one-third of global grain and forty percent of global cropland for production of industrial livestock.¹⁹ Unfortunately, farmed animals are inefficient feed converters. It takes, on average, 2.8kg of *human-edible* food to create 1kg of meat from ruminants such as cows, sheep, and goats, and 3.2kg of *human-edible* food to create 1kg of meat from monogastric animals like chickens and pigs.²⁰ Using this production capacity to feed animals rather than people contributes to human hunger by raising global grain prices and reducing the overall availability of staple crops to feed the world's poorest communities.²¹⁻²² This in turn leaves economies around the world balanced on a house of cards: with unequal access to food and health, global economic development is profoundly insecure.

Current industrial food production works to grow corporate wealth—not human or environmental wellbeing as articulated by the UN SDGs.²³ Especially in Western high-income nations, food producing companies have been getting larger and more consolidated over the last several decades, pushing out or gobbling up smaller businesses at an impressive rate.²⁴ But the effects of this corporate food system do not stop within US borders. Analysis shows, for example, that industrial dairy production around the world is worsening economic challenges for rural communities and increasing dangerous GHG emissions, in the name of profit for a small number of large dairy corporations.²⁵ Major cross-border trade deals like the North American

Free Trade Agreement have maximized corporate profits, while flooding agricultural markets in Mexico with cheap (subsidized) American grain and pushing many small farmers into economic ruin. Corporate consolidation, industrial production methods, and globalized supply chains have together created powerful lock-in effects within the world economy. These lock-ins slow the fight to end global hunger and hamper the development of a sustainable food system that better serves the public good.²⁶

Environmental Costs of Industrial Agriculture

Our food system is currently a key driver of environmental change and degradation.²⁷ Industrial food production around the globe contributes to land use change and deforestation,²⁸ desertification, loss of biodiversity, seventy percent of freshwater use,²⁹ and the pollution of terrestrial and aquatic ecosystems with toxic agrichemicals and nutrient runoff.³⁰⁻³¹ Research commissioned by FAO has estimated the monetary costs of environmental degradation from industrial agriculture to be more than \$3 trillion / year, eclipsing the GDP of the United Kingdom.³²

The Intergovernmental Panel on Climate Change (IPCC) estimates that as much as 37% of global GHG emissions are produced by the food system.

Including pre- and post-production emissions, our agricultural system is responsible for up to thirty-seven percent of the GHGs that drive global climate change.³³ As anthropogenic pressures on land, water, and air intensify, our planet also appears to be entering a mass species extinction on a scale not seen for 65 million years.³⁴ In a dangerous synergy, the effects of climate change will compound and amplify other forms of environmental degradation, and biodiversity loss will

reduce Earth's capacity to adapt to future climate conditions. It is against this backdrop that our current and future food system must operate.

Our global food system is currently approaching or passing many key "planetary boundaries"—the ecological limits for sustainable food production.³⁵⁻³⁶ Passing these boundaries means we are producing food in ways that borrow from the future, damaging farming environments and reducing our ability to produce food for future generations.

In sum, many of industrial agriculture's productivity gains since the 1960s have come at the expense of global environmental health, putting at risk the very ecosystems on which our future food supply depends.

If we do nothing to change our food system's broader impacts, the result could be a worldwide biodiversity and ecosystem collapse.

To make matters worse, FAO estimates that roughly one-third of the food produced via this environmentally costly system is never actually consumed.³ Food that is damaged, cosmetically unacceptable, or uneconomical to harvest because of artificially low farmgate prices is lost before it reaches the consumer. Meanwhile, surplus food and spoiled items are wasted in homes. Together, this wasted production accounts for one-quarter of the GHG emissions from the food system.³⁷ If food loss and food waste were a country, it would be the world's third largest global emitter of GHGs.³⁸

Although a true solution would be far more complicated than simply reallocating all of today's wasted food to fight hunger, reducing this vast amount of food waste could help to fill many empty plates. Reducing food waste is also essential for slowing the growth in future food demand, thus reducing the pressure to intensify farming and convert new lands to agriculture.

Taken together, these problems amount to an existential threat to the current global food system and potentially to humanity itself, not to mention myriad other species. Understanding and limiting the current negative impacts of human activities on the world's ecosystems will be critical for achieving the SDGs.³⁹

II. The Consequences of Producing and Consuming Animals

Around the world, animals in the food system are raised for products such as meat, milk, eggs, fish, wool, feathers, and leather, and for their labor. Within the context of the wider food system and its sustainability concerns, production of livestock—both terrestrial and aquatic—has particularly striking environmental and social impacts on our planet.

Environmental Impacts of Animal Agriculture

Raising and feeding the 70 billion animals slaughtered each year in our global livestock system requires an immense amount of land and resources. It has been estimated that 75–80 percent of the world's overall agricultural land is used to produce livestock and their associated feed crops.⁴⁰⁻⁴¹ From this overwhelming investment of production and land, livestock provide us with only 18 percent of our global calories, and 37 percent of the protein consumed worldwide.⁴²

Meat, dairy, eggs, and fish are by far the most resource-inefficient and resource-intensive food products on our plates.

Many of the nutrients in industrial fertilizers and livestock manure wash away into the surrounding environment, where they cause overgrowth of harmful algae. Decomposing algae absorb oxygen from the water, creating dead zones that literally suffocate aquatic life. More and more of these dead zones have been appearing around the world since the establishment of industrial agriculture, jumping from less than fifty in 1960 to more than six hundred today.⁴³

Feeding both aquatic and terrestrial livestock places a heavy burden on global environments. In 2014, commercial aquaculture overtook wild fisheries as the main source of fish consumed by humans worldwide, hitting record-setting production levels in 2018.⁴⁴⁻⁴⁵ Unfortunately, industrial fish production is simply industrial livestock farming in the sea, with many of the same concerns as industrial livestock production on land. Like intensive farming of terrestrial species, farming of fish has been linked to serious water pollution problems.⁴⁶ Unlike their terrestrial counterparts, many of the fish raised for human consumption are carnivores. So roughly one-fifth of the global commercial fish catch goes to feeding farmed marine species such as salmon and shrimp, and for producing fish oils and fishmeal that are used as nutritional supplements for terrestrial livestock.⁴⁷

In many parts of the world, producing the animals and feed crops to maintain the current terrestrial livestock trade requires constantly converting new lands to agriculture, often at the expense of primary forests. From 1960–2011, producing livestock and animal-source foods is estimated to have caused 65 percent of total global land-use change.⁴⁸ Across Latin America and the Amazon basin, the primary driver of deforestation is the clearing of land to raise livestock and grow animal feed crops. In other primary forests worldwide, livestock and feed are the second-largest driver of deforestation, eclipsed only by timber extraction.⁴⁹⁻⁵⁰

Meeting future demand for meat and animal-source foods through industrial methods would require more than twice the land now devoted to livestock—land we do not have.

In part due to land use change, farmed animal production creates a hefty share of global GHG emissions. Grazing animals release the potent GHG methane directly as part of their digestion, and additional emissions are generated by the decomposition of their manure and the application of fertilizers and agrichemicals to their feed crops. Livestock are responsible for a total of 14.5 percent of all anthropogenic GHG emissions, nearly equivalent to the level of emissions from road transportation worldwide. These emissions include 44 percent of global

methane and 53 percent of global nitrous emissions.⁵¹ Unless livestock production and consumption shift significantly, by 2050 food-related GHG emissions will take up half the planet's total emissions budget under a scenario that limits warming to 2° C.⁵²

The impacts of livestock production become particularly stark when we consider future dietary trends. Diets in many parts of the world are expected to become more animal-based over the next several decades, absent significant intervention. Meeting ballooning future demand for meat and animal-source foods through current industrial animal agriculture would require over twice the land now devoted to livestock—an amount of land we simply do not have.⁵³⁻⁵⁴ Demand for fish is also experiencing a steady rise worldwide, with especially high growth rates in the commercial aquaculture industry.

Thus, industrial livestock production is unsustainable not only because of its impacts on the environment: It is unsustainable because its own core inputs—land and water—are insufficient to meet future demand. The current system simply cannot align with the hard truths of a growing population, changing diets, and this planet's limited natural resources. Change for the livestock industry is unavoidable under any scenario—including continuing industrial production.

Public Health Impacts of Animal Agriculture

Long a topic of debate, consumption of meat and animal products is now increasingly clearly linked with negative health outcomes. In 2015, research by the International Agency for Research on Cancer declared red meat as “probably carcinogenic to humans,” and processed meat—particularly processed red meat—as “carcinogenic to humans.”⁵⁵ A recent review of nineteen long-term meta-analyses, studying the diets and health outcomes of tens of millions of individuals across all regions of the globe, has also demonstrated that regularly consuming more red meat or eggs per day is associated with higher relative risk of chronic illness, stroke, heart disease, and premature death.⁵⁶ Food-producing animals are also the main breeding ground for foodborne pathogens,⁵⁷ and livestock products are disproportionately related to the

most serious outbreaks of foodborne illness.⁵⁸ A growing body of research is also linking livestock production—particularly industrial livestock—to increased public health costs from air pollution and fertilizer runoff from feed crops.⁵⁹⁻⁶⁰ Animal-source foods are thus linked to public health costs from both their production *and* their consumption. Industrial livestock production damages our health at both ends of the supply chain.

70–80% of antibiotic use worldwide is in farmed animals, rather than in humans.

As if that were not enough, current industrial livestock production also impacts our health by intensifying the growing risk of antibiotic resistance. WHO has named antibiotic resistance one of the biggest current threats to global public health, food security, and development.⁶¹ The cramped, unsanitary conditions that millions of animals experience in industrial farming are enabled by routine use of antibiotics in feed, which are liberally delivered to suppress infections and promote rapid growth. Currently, it is estimated that a staggering 70–80 percent of total antibiotic use worldwide is in livestock, rather than in humans.⁶²

Industrial livestock production puts us at higher risk of future pandemics similar to COVID-19.

By 2030, projections place global livestock antibiotic consumption at twice the levels assessed in 2015.⁶³ Many of the antibiotics given to livestock are the same ones used to treat human infections, which weakens their usefulness for humans by increasing the chances that pathogens will develop widespread resistance to common drugs.⁶⁴ Antimicrobial resistance is on the rise around the world, with resistant infections causing 700 million extra hospital days per year in OECD nations⁶⁵ and 700 deaths globally each year.⁶⁶ The World Bank has predicted that this death toll could rise to as high as 10 million per year by 2050, without appropriate action.⁶⁷

Especially important in the wake of the current global pandemic caused by SARS CoV-2 (“COVID-19”), industrial livestock production worldwide is a serious risk factor for generating and spreading future pandemics. 75 percent of the newly emerging diseases detected in humans from 1999–2009 came from animals or from the ingestion of animal-source foods.⁶⁸ The expanding footprint of livestock and their feed crops drives the majority of global deforestation, which increases contact between wild species and humans and is a key factor in the outbreak of new zoonotic diseases.⁶⁹⁻⁷⁰ Continuing to produce livestock industrially puts us at higher risk of future pandemics.

Box 2: Injustice in the Industrial Livestock System

Producing livestock at the scale and intensity needed to support meat-intensive diets in the Western high-income nations comes at great cost for the welfare of both people and animals.

Human Welfare Concerns

Industrial meat and poultry plants in the US employ 1.7 million people. Research by Human Rights Watch[†] has revealed that US meat plant workers are often subjected to abusive conditions including long hours, restricted breaks, exposure to toxic substances, and high danger of bodily harm. From 2013–2017, eight meat plant workers were killed on the job each year. From 2015–2018, one meat plant worker was hospitalized for a work-related injury every two days. Wages in US meat plants are 44% lower than in manufacturing work and have declined farther and faster since 1985. These difficult workplace conditions are maintained by low availability of alternative employment, and active suppression of collective bargaining among workers—the majority of whom are immigrants, women, and people of color.[‡]

Animal Welfare Concerns

An estimated 70 billion animals worldwide live in the cages and feedlots of the industrial livestock system. Many of these animals are subject to abusive conditions including confinement, mutilation, pain, loneliness, ill health, dirty and unsanitary conditions, separation from their offspring, and inhumane slaughter. Journalists have documented the ongoing slaughter of millions of livestock during food processing slowdowns induced by the COVID-19 pandemic^{††}, many of them through intentional shutdown of essential climate and ventilation systems in buildings that house animals.^{*} Animals in the industrial agriculture system are treated as components of an assembly line, discarded as needed to maximize profits, causing immense and unnecessary suffering in the name of food production.

[†] Stauffer, Brian. 2019. “‘When We’re Dead and Buried, Our Bones Will Keep Hurting’: Workers’ Rights Under Threat in US Meat and Poultry Plants.” Human Rights Watch.

[‡] Grabell, Michael, and ProPublica. n.d. “Can Low-Wage Industries Survive without Immigrants and Refugees.” ProPublica. Accessed July 17, 2020.

^{††} “Millions of Farm Animals Culled as US Food Supply Chain Chokes Up.” *The Guardian*, April 29, 2020.

^{*} “Piglets Aborted, Chickens Gassed as Pandemic Slams Meat Sector.” *Reuters*, April 28, 2020.

III. The Promise of Food System Change

In its current form, the global food system is a key driving force behind global environmental degradation. And yet, food production—and farmers worldwide—also bear the worst of the consequences from degraded environments.⁷¹ As serious as it is, this double-edged sword presents an opportunity: Our food system's role as a primary driver of the world's most pressing current and future environmental problems also makes it potentially our greatest tool for creating positive change.

Understanding and limiting the current negative impacts of human activities on the world's ecosystems will be critical for achieving the UN SDGs by 2030.^{72,73} The seventeen SDGs reflect an interconnected web of goals and actions—all upheld by the health of the global food system. Action toward the goals of ending poverty (Goal 1), reducing global hunger (Goal 2), and ensuring healthy lives for all (Goal 3) will require significant improvements in the food system. Feeding 10 billion people well and sustainably will depend on our ability to improve food distribution and food access. Ensuring equality for women (Goal 5), inclusive and sustainable economic growth (Goals 8 and 9), and reducing inequality between nations (Goal 10) are all strongly related to a robust food system that can continue to provide employment and prosperity. Presently, our unsustainable food system, which disregards environmental boundaries and threatens rural livelihoods, promises exactly the opposite of these goals.

The food system drives our worst environmental problems.
It is also potentially our greatest tool for positive change.

Additionally, because our food system impacts so much of the planet already, a sustainable food system is a prerequisite for achieving sustainability in global water use (Goal 6), urban development (Goal 11), consumption and production (Goal 12), ocean use (Goal 14), and terrestrial ecosystem exploitation (Goal 15). Likewise, because our food system is responsible for such a large percentage of global GHG emissions, replacing industrial production with sustainable, ecological food production will be one of our most important tools in the fight

against global climate change (Goal 13). Finally, because the SDGs are all interconnected, a functioning food system is likely to be an important background consideration in the four remaining goals: ensuring equitable education access (Goal 4), sustainable energy (Goal 7), peaceful societies (Goal 16), and global cooperation for sustainable development (Goal 17).

Pursuing the main and interim goals of the SDGs will require a radical departure from industrial agriculture's business-as-usual. Strategic changes to how we produce, consume, and discard our food can enable substantial simultaneous improvements for air, water, land, animals, and human health. Achieving these benefits will require rapid action to transform both food production and food consumption into forces that *strengthen*, rather than *weaken*, our progress toward the UN SDGs.

Production Change Needed to Ensure the SDGs

Industrial agriculture in its current form harms the environment and increases food waste, directly endangering several of the SDGs—but it need not be this way. For the last half century, industrial food production has been optimizing the efficiency of commodity crops using a package of low crop diversity, synthetic fertilizers, industrial agrichemicals, and improved seeds, all coordinated by publicly funded research and promotion. For over fifty years, industrial food production has benefited from a wealth of research and promotion to optimize harvests and make industrial agriculture the dominant model. In the US, over 98 percent of USDA research funding is funneled toward industrial agriculture, maintaining its dominance.⁷⁴ Of the less than 2 percent that goes to any kind of organic or ecological farming, only a small fraction actually funds transformative change. Worldwide, governments spend \$49 billion each year on R&D to improve agricultural efficiency, but less than 1 percent of this yearly spending goes to ecological farming.⁷⁵

More sustainable agricultural models exist. Alternatives such as agroecology can preserve biodiversity, sequester carbon, and regenerate soils, while minimizing external inputs and waste that cannot be recycled as crop inputs.⁷⁶ A multi-year research effort combining the work of four

hundred scientists across fifty-eight countries concluded that a global transition to ecological food production, is critical for safeguarding our food supply and, in turn, human and environmental wellbeing.⁷⁷ Increasing adoption of agroecology globally is recognized by FAO as a key factor in achieving a sustainable food system that can support global sustainable development.⁷⁸

Current industrial production also promotes high levels of food waste throughout agricultural supply chains, as noted above. To reduce the risk of being unable to fulfill harvest contracts if weather conditions suppress crop yields, many farmers have no choice but to intentionally overproduce. Constrained by economic pressures, farmers may also let entire fields of edible food go unharvested if buyers change supply contracts mid-season, or if affordable labor and logistics cannot be arranged at harvest time. Estimates vary, but even with gaps in data, in some cases as much as 40 percent of produce may be lost at the field level through a combination of economic pressures, labor shortages, adjustment of contracts, pest damage, and weather damage.⁷⁹ Significant additional waste is generated during processing, retail, and consumption, where it is harder to accurately document.⁸⁰ Adjusting current supply chain structures and economic incentives that promote food loss on farm fields would help to minimize food loss and waste.

Addressing global hunger without worsening the impacts of climate change will also require reducing the number of animals produced worldwide and shifting production away from the industrial livestock system. From 1961 to 2009, meat production worldwide has more than tripled, with nearly 20 percent of that growth within the final 10 years.⁸¹ FAO estimates that 80 percent of this recent growth has been from industrial animal farming. Globally, confined industrial livestock operations now produce as much as 72 percent of poultry, 55 percent of pork, and 43 percent of eggs.⁸²

Unfortunately, livestock production within the current system continues to rise, along with negative environmental impacts such as production-related GHG emissions. Research by GRAIN and the Institute for Agriculture and Trade Policy (IATP) revealed that in 2018 the top five global

producers of meat and dairy products (JBS, Tyson Foods, Cargill, Dairy Farmers of America, and Fonterra) were together responsible for more climate-damaging GHG emissions than each of three major fossil-fuel companies (Exxon-Mobil, Shell, and BP).⁸³

Changing production will require eliminating policies that support the status quo. Current industrial food production in the Western high-income nations benefits disproportionately from public financial support in the form of subsidies, tax breaks, crop insurance payments, and promotional programs. For example, in the US, government-operated “checkoff” programs promote the consumption of beef, veal, pork, and milk, the vast majority of which come from conventional industrial sources.⁸⁴ Meanwhile, subsidies from the US Farm Bill promote industrial cultivation of corn and soybeans, which have artificially lowered the prices of these industrial livestock feed since 1996.⁸⁵ These subsidies form the basis of today’s industrial livestock system, by maintaining supply of low-priced inputs, and incentivizing industrial practices.

There is also an ongoing incentive for producers to grow larger and more industrialized to realize further economies of scale—which in turn scales up negative impacts on rural economies and the environment. Research in the US has shown that the rapid rise of largescale agribusiness has made it extremely difficult for small and mid-size farmers to continue to make a stable living.⁸⁶ Unfortunately, as corporate farming replaces smaller-scale family farming, bottom lines become the dominant driving force, damaging both community wellbeing and environmental management.⁸⁷

Consumption Change Needed to Ensure the SDGs

To achieve the UN SDGs, significant changes are also needed in how food is consumed. Our demand for processed, low-cost, packaged, and convenience foods provides the market momentum behind modern industrial agriculture, and our dietary reliance on meat and other animal-source foods drives the unsustainable expansion of industrial livestock production. Finally, our purchasing and consumption choices shape how much food we allow to go to waste, both directly at home and indirectly along the supply chain. We can lighten the environmental

impact of our food system by reducing our meat intake and reducing our reliance on foods produced using industrial methods.

From today's figure of 7.7 billion, global population is projected to reach 9.7 billion by 2050.⁸⁸ To feed this many people, many researchers have called for sustainable intensification of the agricultural system to maximize food production within clear ecological limits, and to minimize the amount of new land converted for production.^{89,90} However, research has also shown that intensifying production alone will not be enough to feed ~10 billion sustainably without also changing food demand, particularly by reducing the meat and animal products we consume.⁹¹

Many animal-source foods that are particularly damaging for human health are also the foods that contribute most to animal exploitation and environmental harm.

Consuming fewer animal products, especially meat, can provide win-wins for our health and for the environment. Research shows that many of the foods that damage human health are the very same foods that contribute most to environmental harm.⁹² And while industrial production is especially damaging, a review of 742 production systems worldwide showed that the potential environmental and GHG benefits of shifting our diets from animal-source foods to plant-based foods would outweigh the positive impacts of simply switching from industrial animal-source foods to more sustainable sources of meat, dairy, and eggs.⁹³ In Western high-income nations where consumption of meat and animal products is currently quite high compared to global averages, increasing fruit and vegetable consumption by at least 25 percent and reducing red meat consumption by 78 percent could save as many as 5.1 million lives annually by 2050. Avoiding meat consumption entirely could save 7.3 million lives per year, while avoiding all animal products could save as many as 8.1 million.⁹⁴

Eating fewer animal products provides far greater emissions savings than choosing local meat and animal-source foods.

In the search for individual answers to the large collective problems surrounding industrial agriculture and industrial livestock, many have focused on promoting alternative purchasing habits. Calls for local food, organic food, and animal products from non-industrial sources are common refrains. However, with only a few exceptions, reducing or eliminating meat consumption—especially meat from ruminants such as cattle, sheep, goats, and bison—is nearly always the single most impactful step we can take to reduce our dietary impact. For reducing GHG emissions, eating locally produced meat and animal foods provides only a small fraction of the emissions savings that come from eating fewer animal products of any kind. This is because the vast majority of emissions come from farm-level production practices, not from food transportation.⁹⁵

Unfortunately, FAO estimates that global per capita meat consumption, rather than falling, approximately doubled from 1961 to 2009. Although Western high-income nations are currently responsible for the vast majority of meat, dairy, and egg consumption worldwide, global diets are expected to become more reliant on animal products toward 2050 as populations across the lower- and middle-income nations become more affluent and more urban.⁹⁶ If global consumption of meat, dairy, and eggs is not curtailed by broad-based consumption change, food production in coming decades will place an increasing strain on the global environment.

Lastly, reducing the amount of all food that goes to waste at the consumption stage is another important strategy for minimizing unnecessary environmental impacts, addressing hunger, and bringing us closer to a sustainable food system that delivers on the UN SDGs.⁹⁷ In the high-income nations, many factors contribute to food waste at home, including busy lifestyles, affluence, bulk purchase promotion, improper storage, confusion over best-by dates, and improper portion sizes. We must work to minimize food waste at home and reduce the economic drivers of waste throughout the supply chain.

IV. The Food System of Tomorrow: A Call to Action

We urgently need to adopt a sustainable food system and healthy diets if we are to achieve the multiple health, welfare, and environmental benefits expressed in the UN SDGs. Changes will be needed at global and national scales to create a sustainable food system that can support 10 billion people in a future marked by climate change.

Box 3: Our Call to Action

We must dismantle current industrial animal agriculture to improve the wellbeing of people, animals, and ecosystems. The food system must be restructured to achieve:

Production shift: Change protein production from factory-farmed fish and livestock fed on industrial feed, to plant-based and alternative proteins. Radically decrease food loss and waste at all stages of supply chains.

Consumption shift: Change the focus of diets from industrial processed foods and animal products to more whole and locally produced plant products.

Economic shift: Support alternative models within the food system that prioritize environmentally friendly plant foods, economic equality and inclusion, resilient agroecological methods, and scalable food innovations.

Systemic shift: Replace extractive industrial models of food production with diverse models of ecologically and socially regenerative agriculture. Remove systemic barriers to equal access and opportunity in food and agriculture, addressing racial disparities in land ownership, workers' rights, and food access.

Changes Needed at Global Level

Worldwide, the achievement of the UN SDGs will depend in large part on efforts to reform the food system and shift it away from current industrial methods—both on land and in aquatic production. Change is needed quickly, and the potential promise of the 2021 UN Food Systems Summit for galvanizing political will behind transformative solutions must not be squandered.

Multinational interests and pro-corporate voices must not be allowed to co-opt the UN Food Systems Summit.

As many indigenous leaders and nonprofit voices worldwide have noted, multinational interests and pro-corporate voices, such as those represented by the UN's strategic partnership with the World Economic Forum and the UN Special Envoy Agnes Kalibata, must not be allowed to co-opt the UN Food Systems Summit.⁹⁸ The biggest gains for climate change and human wellbeing will instead come from reducing corporate control and concentration of food supply chains, and from shifting the focus of global food production away from profit and volume and toward greater human, animal, and environmental wellbeing.⁹⁹ Redressing persistent problems such as inequality, racial inequity, and threats to food sovereignty must be part of any viable solution. Truly transformative action on these fronts will be crucial for building a food system that can achieve the SDGs related to addressing global poverty, ending hunger, and reducing inequality.

Worsening animal exploitation must be replaced with viable alternatives, for the good of people, animals, and environmental health. Ecological limits and finite resources are already restraining further growth in industrial animal agriculture. The world can no longer support the continued unlimited expansion of conventional terrestrial livestock and farmed fish. At the same time, consumer demand for healthier, more environmentally focused alternative proteins has seen a meteoric rise in many high-income countries. Continuing to invest resources in industrial animal production without an eye toward environmental impact, animal welfare, and the viability of alternative plant-based proteins now carries serious market risks for food producers of any size, and for regional and national food webs.¹⁰⁰

To better support human growth and development, global terrestrial agriculture will need to pivot from high-input, low-diversity crop production dependent on patented seeds and industrial agrichemicals, toward agroecological methods that protect soil and enhance ecosystem services while empowering rural producers. Where regional yield intensification is

needed and appropriate, specific, community-controlled, sustainable approaches must be adopted in lieu of solutions relying on industrial inputs or managed by external groups.

Confronting the threat of climate change and the ways in which food production both drives and is vulnerable to it, will be a critical part of food systems reform. Actions to address climate change under SDG 13 will likely have positive synergistic effects on the SDGs related to food security, poverty, and equity.

Meeting environmental targets for clean air, water, and land will require immediate and lasting global reductions in industrial livestock production, and de-emphasizing animal products in current and future diets.¹ According to a report by the EAT-Lancet Commission, an appropriate diet is one that provides sufficient calories and nutrients, contains a variety of plant-based foods, is low in animal products, focuses on unsaturated rather than saturated fats, and minimizes reliance on refined grains, highly processed foods, and added sugars (the “Planetary Health” diet).¹⁰¹ Reductions in production and consumption of animal-source foods are especially important for higher-income nations, to strengthen food access in lower-income nations and support more equitable distribution of food resources worldwide.

The 2021 UN Food Systems Summit will succeed or fail at its stated mission of delivering the SDGs, in accordance with how well it achieves global partnership and political commitment to address these interconnected problems. Transformative goals and the power to implement them will mean little if the voices of the communities affected by present food system failures, along with future responses, are not integrally involved in shaping solutions. To achieve the promise of the SDGs, the summit and its outcomes must be rooted in radical inclusion, clearing systemic barriers to democratic participation, and prioritizing the public good over multinational business interests.

¹ Setting aside ethical considerations surrounding animal welfare, some forms of livestock rearing (under high-welfare conditions and with minimal environmental impacts) may form part of a sustainable future food system that delivers a range of social and environmental benefits. However, animal-source foods produced using such practices currently represent as little as 1 percent of existing livestock production, and the larger space requirements of raising animals outside of confinement would make it unfeasible to scale sustainable animal agriculture to the size of current demand.

Changes Needed at National Level: The United States

The US is currently a global leader in both industrial livestock production and per-person consumption of animal products. Reforming the US food system is therefore a crucial part of redressing the global harms of industrial agriculture. The most impactful changes for the US will include a mix of consumption and production strategies designed to reduce GHG emissions, improve ecosystem health, rebalance rural economies, and address systemic racism and inequality.

Reduce livestock production and meat consumption

Sustainable production shifts must be encouraged and supported by a broad spectrum of changes in institutional purchasing and consumer demand. Possible solutions include increasing the availability and diversity of plant-based meats from existing plant protein sources, producing novel proteins by precision fermentation,¹⁰² and promoting consumption of traditional plant-based foods such as nuts, seeds, and legumes. Dietary change will likely bring simultaneous benefits for environmental goals and human health. In a study of US consumers, diets that reduced meat, dairy, saturated fats, and sodium in favor of more plant proteins, grains, and fiber scored higher nutritionally while generating four-fifths fewer GHG emissions than meat-heavy diets.¹⁰³ If US beef production and consumption could be replaced equally with beans, this simple switch would free up 42 percent of US cropland for other uses and reduce GHG emissions by 334 million metric tons—75 percent of the total emissions reduction required of the US to meet global targets for limiting climate warming to 2° C.¹⁰⁴ No matter what other measures are pursued, significantly reduced consumption of dairy and ruminant meat will be an essential part of any global plan for achieving the 2° C target.¹⁰⁵ Reduction, if not full vegetarian or vegan diets, also reflects already-emerging US consumer trends: two-thirds of US consumers in a 2018 Johns Hopkins poll claimed to be reducing their meat consumption, due to concerns ranging from cost and health to animal welfare and environmental impact.¹⁰⁶

Address systemic racism and inequality in the food system

To contribute to improving human and environmental wellbeing, the US food system must contend with existing sources of economic disenfranchisement, poverty, hunger, and lack of inclusion. A history of deep racial, ethnic, and socioeconomic injustices permeates the US food system, affecting farming demographics, what crops are grown where, and how Americans eat.¹⁰⁷ Transforming US agriculture in line with the goals of the UN SDGs will require addressing the systemic racism and growing economic inequality that threaten both human and environmental progress. The same social and economic factors that have propped up the growth of large, concentrated agribusiness empires have also worsened food access inequality for communities of color, reduced the diversity of farm ownership, and perpetuated race and class divides through food and health.¹⁰⁸ Addressing these systemic injustices and dismantling institutionalized discrimination—for example, by boosting the availability of small business loans and financial support to low-income farmers and farmers of color, while increasing funding for nutrition assistance programs that support underserved communities—must be part of sustainable US food system reforms.

Redirect public agricultural subsidies

To create a more sustainable food system capable of supporting the UN SDGs, the US needs an overhaul of public support for food and agriculture. Current subsidy structures foster food waste, promote production of industrial livestock and processed foods, and reward the corporate concentration that harms rural economies and the environment. The unsustainable levels of food waste on US farms and in processed-food supply chains is driven by the subsidized economics of industrial agriculture and the focus on financial efficiency that they prioritize. Halving food loss and waste alone could reduce the environmental impact of the US food system by 8–10 percent.¹⁰⁹ Public financial supports for farming must be restructured so that less food is left to waste in fields simply because it is uneconomical to harvest. At the same time, subsidies that increase the power of agribusiness must be addressed. Control of US meat production by agribusiness funnels profits away from rural communities, while locking in the

industrial agriculture system: The top four US beef producers control 85 percent of overall market share. For pork, this number is 66 percent, for turkey 57 percent, and for broiler chickens, 51 percent.¹¹⁰ In such concentrated industries, the leading vertically integrated brands wield immense control over all stages of the supply chain, from feed crops to final retail.¹¹¹

Subsidy change is likely to be one of the most effective levers for reorganizing food systems.¹¹² Public spending that recognizes the links between industrial livestock production and environmental harm can help to correct market failures, adding needed support to incentivize environmental solutions. For example, incorporating climate change mitigation goals into the US Farm Bill would help to correct distorted incentives that currently drive climate-damaging production.¹¹³

But current US farm subsidies and dietary guidelines—designed to maintain production of industrial livestock and surplus commodity crops—will not incentivize alternative strategies for protein producers or promote positive dietary changes for American consumers.¹¹⁴ The US must remove or redirect subsidies that currently reward large corporate agribusiness and promote unsustainable overproduction of industrial grains, milk, meat, and oilseeds. Instead of subsidizing industrial livestock production, a wiser path would be to place a moratorium on new or expanding confined animal feeding operations (CAFOs), and to place restrictions on overall GHG emissions from large CAFOs.¹¹⁵ State financial supports should instead serve public health and rural economies, by incentivizing smaller farms that produce diverse plant foods that support healthy diets.

V. Conclusion

Radical change is needed throughout the food system to support human wellbeing and environmental health—the building blocks of sustainable development. Food system change is our best tool for supporting the seventeen UN SDGs, thirteen of which will be impossible without radical action to put current methods of food production and consumption on a more sustainable path. And there is no time to waste: food system transformation before 2050 is

critical for ensuring our future social and economic wellbeing, and the health of the global ecosystems that sustain us.¹¹⁶

The year 2021 is a critical period for global action. COVID-19, in addition to its enormous and ongoing toll on human life, is disrupting food production and food distribution for vulnerable populations around the world and posing serious challenges to local and regional economies. It is also revealing more clearly, to more people than ever before, the weaknesses and empty promises of the industrial food system. With those revelations comes the potential for collaboration to advance the dialogue of food systems, bringing truly transformative solutions within reach.

Taking shape against the backdrop of the global pandemic, the planned UN Food Systems Summit promises to answer this crucial moment with the first international event devoted to the role of food systems in addressing the challenges of global development. The summit offers a platform for multilateral action to create a sustainable food system and realize the SDGs. However, without immediate action to center the voices of global civil society and limit the power of multinational corporations, the summit may fail to provide a much-needed pathway for action toward human, animal, and environmental progress.

For the food system, change is here one way or another—how we respond to it will define our tomorrow. If we are to achieve a food future within the context and timeframe of the UN SDGs, we must drastically reduce our reliance on industrial agriculture and animal products. We must instead transition to diverse, inclusive agricultural systems that restore and protect global ecosystems, reduce exploitation of animals, empower producers, and prioritize the health and wellbeing of all food consumers.

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