Food System Economics *Commission*

GLOBAL POLICY REPORT

Executive Summary
The Economics of the Food System Transformation

EXECUTIVE SUMMARY

The Food System Economics Commission

The Food System Economics Commission is an independent economic commission composed of: Ottmar Edenhofer (Co-chair, Potsdam Institute for Climate Impact Research, PIK); Ravi Kanbur (Co-chair, Cornell University); Vera Songwe (Co-chair, Africa Growth Initiative at Brookings); Francesco Branca (World Health Organization); Simon Dietz (London School of Economics); Shenggen Fan (China Agricultural University); Jessica Fanzo (Columbia Climate School); Jayati Ghosh (University of Massachusetts Amherst); Naoko Ishii (University of Tokyo); Rachel Kyte (Tufts University); Hermann Lotze-Campen (Potsdam Institute for Climate Impact Research, PIK); Wanjira Mathai, Susan Chomba and James Wangu (World Resources Institute Africa); Stella Nordhagen (Global Alliance for Improved Nutrition); Rachel Nugent (RTI International; University of Washington); Jo Swinnen (International Food Policy Research Institute and CGIAR); Maximo Torero, David Laborde Debouquet and Panagiotis Karfakis (Food and Agriculture Organization of the United Nations); Juergen Voegele and Geeta Sethi (World Bank); Paul Winters (Notre Dame University). Barbara Harriss-White's (University of Oxford) invaluable contribution as a Commissioner until the middle of 2023 is gratefully acknowledged.

The Food System Economics Commission was convened by Gunhild Stordalen (EAT), Jeremy Oppenheim (Food and Land Use Coalition, FOLU) and Johan Rockström (Potsdam Institute for Climate Impact Research, PIK).

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The Economics of the Food System Transformation

A transformation of food systems is urgently needed, possible, and offers enormous economic benefits

Our food systems — the way we produce, market, and consume food — are part of the political, social, economic, ecological, and cultural fabric of our communities. They have achieved something of a miracle, keeping pace with decades of population growth while decreasing some forms of malnutrition, reducing poverty and increasing life expectancy. But progress has been uneven around the world. And the recent evolution of food systems has fuelled – and continues to inflame – some of the greatest and gravest challenges facing humanity, notably persistent hunger, undernutrition, the obesity epidemic, loss of biodiversity, environmental damage and climate change. The economic value of this human suffering and planetary harm is well above 10 trillion USD[1] a year, more than food systems contribute to global GDP. In short, our food systems are destroying more value than they create.[2]

Ignoring the consequences of today's food systems locks the world onto a course that escalates their negative effects disastrously. Yet in many policy discussions, such as those around climate change, food systems have long been ignored. Concerns for food affordability and the livelihoods of hundreds of millions who depend on food systems, the power of large-scale players, and divergent views among stakeholders about what sustainable food systems look like have all contributed to make food systems something of an exception. Today there is an opportunity for policymakers to raise the level of ambition. Transforming food systems worldwide provides a uniquely powerful means of addressing the global climate, nature and health emergencies while offering a better life to hundreds of millions of people.

This report identifies the elements of what a transformation from today's food systems to an inclusive, health-enhancing and environmentally sustainable global food system entails. It shows that such a transformation is not only biophysically and technically feasible; it offers immense economic benefits to societies across the world. The net benefits of achieving a food system transformation are worth 5 to 10 trillion USD a year, equivalent to between 4 and 8 percent of global GDP in 2020. Combined with transitions taking place outside the realm of food, notably to low-emission energy, a food system transformation can ensure that global warming stays well below 1.5 degrees C at the end of this century.[3]

The economic and planetary case for transforming our food systems is compelling. But negotiating change across a multitude of diverse stakeholders with unequal power and varying prospects from the transformation is an enormous challenge. The report confronts this challenge head on, highlighting practical ways to dismantle barriers to change and develop achievable transformation strategies. Evidence shows that embracing equity and inclusion is key to making a transformation politically viable and thus essential for success.

The report summarizes the findings of a four-year investigation by the Food System Economics Commission (FSEC), an independent commission expressly created to assess options for comprehensive food system transformation. FSEC findings are based on rigorous economic modeling, in-depth literature reviews, and case studies. All background research is available at foodsystemeconomics.org.

1 Unless otherwise specified all figures are in USD Purchasing Power Parity (PPP) 2020.

2 It is not possible, either conceptually or analytically, to separate the production of non-food agricultural items from food items. In this report "food systems" is used as a short-hand for agri-food systems.

3 The food system transformation addresses both direct emissions of greenhouse gases (such as e.g. methane from ruminant enteric fermentation and nitrous oxide from crop production) and indirect ones (through land-use change).

The costs of current food systems are far larger than their contribution to global prosperity

Food systems form a nexus linking some of the greatest triumphs and challenges of our times. Thanks to human ingenuity, determination and technical progress, they feed a world population that has doubled since the 1970s. And yet the unaccounted costs of the burdens they place on people and the planet are currently estimated at 15 trillion USD a year, equivalent to 12 percent of GDP in 2020. This finding is in line with other recent estimates in the literature. These unaccounted costs comprise:

- Health costs, which FSEC estimates to be at least 11 trillion USD. The economic costs of ill health due to food systems are measured through their negative effects on labor productivity. Those are driven by the prevalence of non-communicable diseases, including diabetes, hypertension, and cancer which can be attributed to food. A large share of this burden is born by people living with obesity, currently estimated at 770 million people. FSEC's health costs also include a lower bound figure for the productivity costs of undernutrition, currently affecting 735 million people.

- Environmental costs are estimated at 3 trillion USD a year and reflect the negative impacts of today's food systems on ecosystems and climate, including the impacts of current agricultural land use and food production practices. These practices are responsible for a third of global greenhouse gas emissions, including emissions arising from deforestation, and result in the net loss of over 6 million hectares of natural forest each year. Environmental costs also reflect the costs of biodiversity loss and environmental damage arising from nitrogen surplus, which leaches into waterways and pollutes the air.

- Finally, food systems are a source of structural poverty through the costs of food, but also through the low incomes of many who work in food production. The incidence of poverty tends to be higher in agriculture than in the other segments of food systems.

The global food system is on an unsustainable trajectory and current policy commitments are not strong enough to divert it

Even if countries follow through on all the policy commitments made in their Nationally Determined Contributions (NDCs), they will not succeed in shifting the global food system from its unsustainable trajectory. It will still be responsible for about one third of future global emissions if current trends in the overall economy prevail to 2050. These emissions will contribute to an increase in global mean temperature of 2.7 degree C by the end of the century,[4] compared to pre-industrial periods. But the negative impacts of the current trajectory go well beyond climate.

The continuation of current trends to 2050, modeled through the Current Trends pathway (CT), has further striking features:

- Food insecurity and undernutrition continue to plague humanity, still leaving 640 million people, including 121 million children, underweight in 2050, particularly in India, Southeast Asia, and Sub-Saharan Africa.

- The global adoption of diets high in fats, sugar, salt and ultra-processed foods would increase the number of obese people worldwide by 70 percent to an estimated 1.5 billion in 2050, or 15 percent of the expected global population. Note that the direct medical costs of treating the health consequences of overweight and obesity have been estimated by others to rise from 600 billion USD today to almost 3 trillion by 2030 already.

4 Under current trends warming at the end of the century also coincides with "peak warming".

- → Per capita food waste increases by 16 percent compared to today, reaching 76 kg of dry matter per capita in 2050.

- → Food production in many countries becomes increasingly vulnerable to climate change and environmental degradation, with the likelihood of extreme events dramatically increasing. Rising food prices due to climate or other shocks heighten poverty and hunger, stretching the budgets of the poor and middle classes. This leads to social tensions and the imposition of measures to limit trade.

- → Deforestation will erode a further 71 million hectares of natural forests between 2020 and 2050, an area equivalent to 1.3 times the size of France. This has far-reaching implications for carbon emissions and biodiversity loss.

- → Nitrogen surplus from agriculture and natural land also increases from 245 Mt to about 300 Mt a year, polluting water, destroying biodiversity and undermining public health.

Transforming food systems would provide economic benefits equivalent to at least 5 trillion USD a year

FSEC has assessed one specific science-based transformation pathway for food system which brings huge benefits for both people and planet. This pathway is called the Food System Transformation (FST). Estimates of those benefits, measured as reductions in the unaccounted costs of food systems outlined above, amount to at least 5 trillion USD per year. When the full effects of a global food system transformation on incomes are factored in, estimates of its benefits rise to 10 trillion USD per year (Box ES.1). The FST offers a future where:

- → Undernutrition is eliminated by 2050, and cumulatively 174 million lives are saved from premature death due to diet-related chronic disease, compared to CT. This fall in diet-related chronic disease accounts for 55 percent of the reduction in the food system's hidden costs associated with the FST (see figure ES.1). When accounting for the impacts of changing diets on both consumption and (indirectly) on land use, changing diets accounts for 70 percent of the benefits of transforming food systems.

- → Farmers in the global food system — around 400 million people — enjoy a sufficient income from their work thanks to productivity growth and targeted support policies.

- → An additional 1.4 billion hectares of land is protected, while a further 200 million hectares are afforested and open to planet-friendly economic uses such as the production of timber for housing.

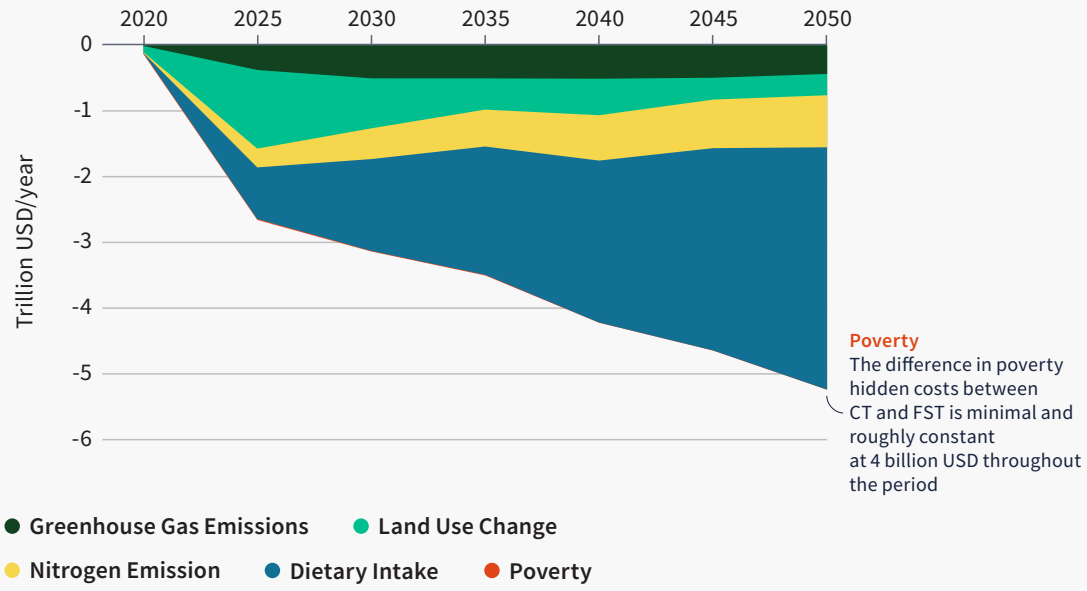
- → A shift to environmentally sustainable production in agriculture reverses biodiversity loss, reduces demand for irrigation water and almost halves nitrogen surplus from agriculture and natural land (i.e. land that has not been altered or developed for human purposes).

- → The food system becomes a net carbon sink by 2040. As part of a larger sustainability transformation which includes the energy sector, this helps to ensure that global warming is limited to well below the 1.5 degree C Paris Climate target by the end of the century, with peak warming barely exceeding 1.5 degree C.

- → Processes of structural transformation are accelerated, meaning that agriculture becomes less labor-intensive than under CT. About 75 million more on-farm jobs are reallocated to other segments of food systems or other sectors than expected under CT.

This alternative future plays out differently in different parts of the world. A shift to healthy diets entails notably higher consumption of fruits, vegetables and nuts in South and South-East Asia and of legumes in China. Meanwhile, consumption of animal-sourced food decreases drastically in high- and middle-income regions.

FIGURE ES.1
Reduction in hidden costs compared to Current Trends
Trillion USD PPP 2020



The Northern Hemisphere sees the largest increase in land conservation over CT, while one half of the projected additional afforestation happens in Brazil. And food waste is reduced most in some European countries, the USA, and China.

At 200–500 billion USD a year, estimated costs of global food system transformation are low compared to its economic benefits

Implementing the FST pathway worldwide will need investments and transfers averaging 500 billion USD each year between now and 2050. Of this amount, about 200 billion USD covers investments in rural infrastructure (including roads, irrigation expansion, access to energy), the protection and restoration of forests, the reduction of food loss and waste, support for the dietary shift and agricultural research and development. All these costs are additional to spending already expected in these areas.

The remainder of the transformation costs cover the safety net support needed to keep food affordable for the poorest, especially in the earlier phases of the food system transformation. Under the FST, agricultural commodity prices increase by roughly 30 percent by 2050, which may significantly increase the prices consumers pay for food. Food price rises will be somewhat offset by rising incomes and changing consumption patterns. However, the risk of food becoming less affordable for the poorest needs to be addressed head on with transfer programs. The initial estimate of FSEC is that this might require up to 300 billion USD a year, based on spending patterns of the poor in low income countries. This estimate needs to be refined depending on local circumstances, including national programs' ambition and how they are scaled up over time, the specific income groups expected to benefit, local household vulnerability to price increases and the availability of resources and capacity needed to operate transfer programs.

Given strained post-COVID budgets and recent geo-political shocks, financing the costs of transforming food systems will be a difficult hurdle for low- and middle-income countries to overcome.

It risks putting the benefits beyond their reach, even though these far outweigh the costs. Yet at a global level, the costs of the food system transformation are equivalent to only 0.2–0.4 percent of global GDP, and clearly affordable compared to the global benefits. New resources, such as those currently under discussion as part of the Multilateral Development Banks reform agenda, could support these efforts.

Five broad priorities can guide national food system transformation strategies

Global food system change will in reality take place at national and local levels. There is no universal recipe for what each transformation should look like, but five broad priorities can guide national and local strategies everywhere. Bundling policies into coherent strategies to pursue these priorities maximizes the likelihood of impact:

Shifting consumption patterns towards healthy diets. A global shift towards healthy diets is the biggest source of benefits in the FSEC FST pathway. Changing what people choose to eat is not easy but policies that have been shown to work include: regulating the marketing of unhealthy foods to children; front-of-pack nutritional guidance; targeting public food procurement on healthy options; taxing sugar-sweetened beverages and unhealthy foods; and reformulating packaged food. These policies can be applied at scale, but more work is needed to find new ways to shift consumption patterns and improve access to healthy food, as well as more research on which policies work best and why.

Resetting incentives: Repurposing government support for agriculture. Most agricultural support from governments benefits larger producers and much is linked to harmful environmental, climate, and health effects. Reforming agricultural support to make sure it incentivizes choices in line with the goals of the food system transformation could lower food systems' hidden costs. For example, repurposed subsidies could help to improve access to healthy diets and make them more affordable. However, subsidy repurposing might displace production to less efficient countries thereby increasing environmental impacts. This calls for investments to improve productivity and contain environmental impacts, possibly through international redistribution.

Resetting incentives: Targeting revenue from new taxes to support the food system transformation. Transforming food systems into net carbon sinks and reducing nitrogen pollution are two important sources of benefits. Taxing carbon and nitrogen pollution to help achieve these outcomes is in line with recommendations from expert bodies including the IPCC and OECD. But new taxes must be designed to suit the local context. Targeting resulting revenues towards direct and progressive benefits for poorer households that might otherwise struggle to afford food can ensure its outcomes are inclusive and help to win political support for a food system transformation.

Innovating to increase labor productivity and workers' livelihood opportunities, especially for poorer workers in food systems. An unprecedented number of new food system technologies is being developed. Currently this comes largely from the private sector. National and international public institutions can do a lot to speed up the development and diffusion of innovations that meet the needs of poorer producers and remove barriers to their adoption. Priority areas for public research and innovation include: improving plant breeding in low- and middle-income countries; supporting environmentally sustainable, biodiversity-friendly, and low-emission farming systems by, for instance, tailoring public procurement and extension services; and developing digital technologies useful to small farmers, such as information systems based on remote-sensing, in-field sensors and market access apps.

Scaling-up safety nets to keep food affordable for the poorest. Developing and strengthening safety nets is key to making food system transformations inclusive and politically feasible. Experience with cash transfers during the COVID pandemic has redefined what is possible, in terms of making efficient digital payments and targeting vulnerable populations. Countries might decide to start by targeting limited transfer resources on children, whose nutritional needs are critically linked to their lifetime achievements, while mobilizing more resources and putting in place more comprehensive safety nets.

Failure to address head on the tensions surrounding food system transformation will hold back change

Transforming food systems brings huge benefits but it also gives rise to unavoidable tensions among potential winners and losers. Managing these tensions calls for new ways of implementing policies. Unless they are addressed, these tensions will stymie change. Issues likely to require management include:

Fears of food price rises. Increasing hunger and worsening food insecurity caused by rising food prices can lead to social unrest, especially when politically powerful populations are affected. For good reason, the price of food is considered by governments and opposition parties as an important barometer of their prospects for re-election or election. Concerns about the future affordability of food can paralyse food system reforms, as well as resulting in disruptive policy responses such as export bans. Putting in place effective safety nets, as proposed by FSEC above, is crucial to lifting this barrier to change.

Fears of job losses. Transforming food systems can accelerate the reallocation of jobs away from food production. Localized impacts can be severe when transforming food systems affects the main sources of livelihoods. Developing downstream segments of the food system can help create jobs for farm workers displaced by food system change, particularly in low-income countries. Deploying nature-based agricultural practices such as agroforestry can do the same. The shift towards healthy diets is also likely to create new jobs: the ILO expects some 15 million additional jobs from this source in Latin America alone. But for these new developments to absorb at scale labor shifting from obsolete forms of food production they will need well-targeted investment in productive infrastructure, skills and more equitable access to finance – notably for women farmers.

Policy siloes. Numerous government ministries and departments influence food systems. They often pursue disparate, overlapping, and sometimes contradictory policy goals, and their decisions are rarely informed by the views of other stakeholders. While most governments now recognize the urgent need to reform food systems, to ensure success they need to convene more participatory forms of food system governance, develop clear, long-term strategies with transparent accountability, and coordinate their implementation of policies.

Global inequalities. While the food system transformation is a clear win at the global level, there are tensions surrounding the distribution of its benefits and costs. The required dietary shift will reconfigure production patterns, likely concentrating many of the costs in some producer countries. Richer producer countries are equipped to contain and mitigate adjustment costs but they are clearly unaffordable for many low-income countries. Food system reforms need to be prioritized for climate finance, in global public health interventions and agreements, and on the agendas of multilateral development banks to be sure of progress at the necessary scale and speed.

Entrenched vested interests. Food systems are characterized by marked asymmetries in power, information, and accountability. Powerful corporations often use their influence over policymaking to delay or dilute reforms perceived as a threat to shareholder value. FSEC highlights three ways to assert the public interest in food system reform based on successful examples of generating

change. First, emphasize the intended public benefits, such as better child health and lives saved by healthier diets, to build constituencies for reform. Second, form broad-based, multi-stakeholder coalitions to challenge corporate power. Coalitions were instrumental in persuading governments across Latin America to raise taxes on sugary beverages despite corporate lobbying against them. Finally, when using new taxes to change incentives, link the tax revenue directly to interventions which command broad support. For example, Bolivia finances its healthy school meal programs from a tax on hydrocarbons, converting natural capital into human capital.

Daunting as the challenges of transforming food systems may be, there are reasons to be hopeful. Over recent years transforming food systems has risen in visibility as a policy priority. From citizen movements to farmers to businesses, new groups and coalitions are innovating to make food systems more sustainable. New technologies and business models are expanding the scope of what is possible. The COP28 UAE declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action signed by over 150 countries signals a new ambition to seize the opportunities offered by transforming food systems.

Addressing squarely the concerns that shape policymakers' vision of what is possible offers a pathway to reap large benefits for people and planet.

BOX ES.1
Modelling the Food System Transformation

To understand the food system transformation in a scientifically rigorous way, FSEC explored food system pathways generated using the modeling framework MAgPIE (Model of Agricultural Production and its Impact on the Environment, Dietrich et al. 2019). MAgPIE projects how the agriculture and food sector may change over time given a consistent set of socio-economic assumptions and biogeophysical constraints. Its modelling capabilities are extended through coupling it with specialized models of public health (Springmann et al. 2018), the energy system (Baumstark et al. 2021), and the climate system (Meinshausen et al. 2020). FSEC uses the resulting pathways to produce economic valuations of the gross and net economic benefits of the food system transformations that they capture.

This report focuses on two such pathways. "Current Trends" (CT), represents a continuation of the trends that characterize food systems today. The "Food System Transformation" (FST), characterizes a global effort to transform current food systems into a global system that produces healthy, nutritious food without sacrificing a livable environment, meets the needs of those working in agriculture and lifts up the world's poor and hungry. A third pathway, elaborated in Chapter 3, embeds the FST within a more general sustainable transformation that is largely external to the food system. This includes more optimistic assumptions for future GDP and population growth as well as the ongoing energy transition.

The Current Trends (CT) Pathway
The Current Trends pathway projects a future extrapolated from past trends and the present. Absent deep structural changes in the world economy, global GDP expands by over 100 percent by 2050, yet this prosperity is unevenly distributed. Poverty rates decline, but entrenched structural disparities ensure that a considerable portion of the global population remains impoverished. Food production scales to meet the needs of that global population, expected to reach 9.5 billion by 2050, but 640 million people remain undernourished. At the same time, the increasing prevalence of unhealthy diets in richer countries contributes to a surge in obesity, affecting nearly 1.5 billion people in 2050. Regarding climate change mitigation, nations adhere to their current Nationally Determined Contributions (NDCs), increasing managed forestry by 230 million hectares to reach 560 million hectares globally. Yet, inadequate international cooperation hampers further progress toward the 1.5 degree climate goal, and earlier powerful ambitions to meet the Paris climate targets lose momentum. Agricultural expansion and overexploitation of natural resources further degrade natural ecosystems and the biodiversity they foster.

The Food System Transformation (FST) Pathway
The Food System Transformation pathway projects an alternative future, defined by worldwide commitment to achieving an inclusive, health-enhancing, and environmentally sustainable food system. Over the next thirty years, all countries gradually transition away from diets dominated by empty calories and animal-sourced proteins, and instead increase their consumption of vegetables, fruits, nuts, legumes, and whole grains. Resolute action eliminates hunger by 2050, sparing 640 million people the pain of going to bed hungry, or not knowing what their children will eat the next morning. Enormous swathes of natural ecosystems are protected from development, and ambitious re/afforestation programs begin to expand managed forests by 2.5 million hectares each year from today to 2050. These efforts, together with technological progress reducing agricultural pollutants, ensures the land-use sector becomes a net carbon sink by 2040. Campaigns to fight poverty in the agricultural sector are successful, ensuring living wages for the almost 400 million people who work in it. Simultaneously, the transition away from expensive and wasteful diets, coupled with redistribution of carbon taxes, guarantees that food remains affordable.

The gross and net economic benefits of the food system transformation
FSEC uses two distinct but complementary methods to assess the economics of transforming food systems: an aggregate top-down approach and a detailed bottom-up approach. The top-down approach (Dietz, 2023) calculates the aggregated impacts of the FST in terms of health, environment, and income, expressing changes in social welfare in monetary terms. The bottom-up approach (Lord 2023) quantifies the hidden costs avoided by the FST, including those related to health, environment, and poverty. The bottom-up approach estimates the value that present or future economies may lose from poor health or environmental pollutants like GHG emissions or nitrogen surplus. While both methods are grounded in welfare economics, the top-down method aims for a holistic measure of societal well-being, while the bottom-up approach focuses on tangible, itemized costs. Together, they provide a comprehensive understanding of the economic impacts of food system transformation on a global scale.

For a full list of references, please visit foodystemeconomics.org.

TABLE ES.1
Packages of measures modelled by FSEC

Operational Goal	Food system measures
Diets Consumption of healthy diets by all	• Eradication of undernutrition • Stabilization of obesity • Convergence towards healthy diets • Halving food waste
Livelihoods Strong livelihoods throughout the food system	• Trade liberalization • Wage increases in agriculture • Capital substitution
Biosphere Protection of intact land and restoration of degraded land	• Reducing emissions from deforestation and forest degradation (REDD+) • Land conservation • Peatland rewetting • Water conservation • Biodiversity offset
Production Environmentally sustainable production throughout the food system	• Nitrogen efficiency • Longer crop rotations • More landscape habitats • Emission mitigation from rice cultivation • Livestock management • Manure management • Soil carbon management
External Sustainable transformations external to the food system	• Slower population growth • Equitable human development • Sustainable energy transition • Increase in bioplastics • More timber construction

Background Papers

All background papers are available at foodsystemeconomics.org

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